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RADIO AGE

PACIFIC OCEAN

INDIAN OCEAN

The Magazine of the Hour

VOL. 1. MAY, 1922. NUMBER 1

.. IN THIS NUMBER ..

How to Make a Home Radio Set for $6.
An Official U. S. Government Article For Boys.

Chicago Boy's Simple Directions for Making Radiophone at Home.
Fully and Clearly Illustrated.

Questions and Answers.
They Simplify Your Own Radio Problems.

How to Get a Good Radio Set---*Free.*

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A MAGAZINE FOR A MILLION FANS

For Beginners, Experts, Dealers, Jobbers, Manufacturers

$2.50 a Year - - - - - - - 25c a Copy

Radio Age

PROSPECTUS

OUR special field: The Middle West and the West. This includes the "Chicago Territory" which is unquestionably the richest agricultural, commercial, financial and *industrial* region in the world. Radiophones according to late figures published through the Associated Press, are being used in four States as follows: Iowa, 23,000; Missouri, 25,000; Nebraska, 22,000; Kansas, 20,000; Wisconsin, 1,500 stations, increasing at the rate of 5 a day. Cleveland alone has 15,000 amateur and professional radio enthusiasts; St. Louis, 2,200; Dallas, 263; Cincinnati, 500; Indianapolis, 1,000; Milwaukee, 1,000. Schools and colleges in all states are teaching radio, farmers all over the Middle West are installing radio sets; clubs are being organized everywhere.

Chicago—Radio operatives are growing in number so rapidly that their number could only be approximately estimated. Thousands of boys are studying practical radio science in the public schools. Dealers and manufacturers are unable to supply the demand for equipment.

Our special circulation: Boy beginners particularly, and amateurs generally. Radio Age will write Radio so that boys can understand it. There will be technical articles for the advanced students of Radio but the departments for beginners will not be written OVER THE READERS' HEADS. Numerous illustrations will aid amateurs in constructing HOME RADIO SETS. Getting a printed message across is simply one form of SALESMANSHIP and it is a highly specialized line. Radio Age knows its market and knows how to supply it.

Our special departments: In addition to illustrated articles showing beginners how to launch out into the ether waves there will be original articles written by boys telling what they have done in Radio and how. There will be a Questions And Answers department, carefully handled; Radio Clubs will have attention with liberal use of names of individuals and photographs; there will be a department for Trade News, a Radio Readers' Exchange, for letters of interest from our readers. These features will be supplemented by articles presenting facts about the growth of radio in popularity, about the constantly increasing list of practical uses for radio, about the importance of radio in its relation to society generally. Radio Age will have no narrowed view of its subject.

It is the hour of Radio. We offer—

"The Magazine of the Hour"

Radio Age, The Magazine of the Hour, published on April 8; a monthly magazine, Vol. I, No. 1. Publication office, Garrick Building, 64 W. Randolph St., Chicago, Ill. Subscription price $2.50 a year. Published by the M. B. Smith Publishing Co. Entry as second class matter applied for at the postoffice at Chicago, Illinois, under the ACT of March 3, 1879.

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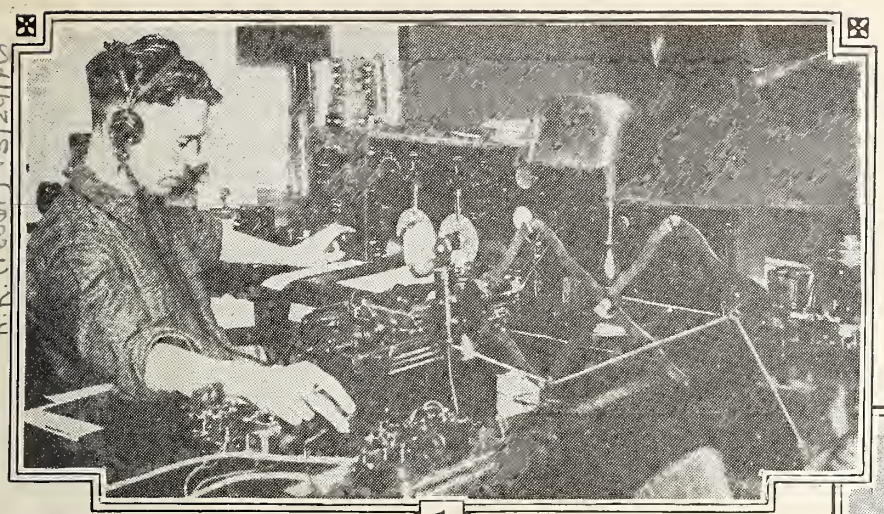

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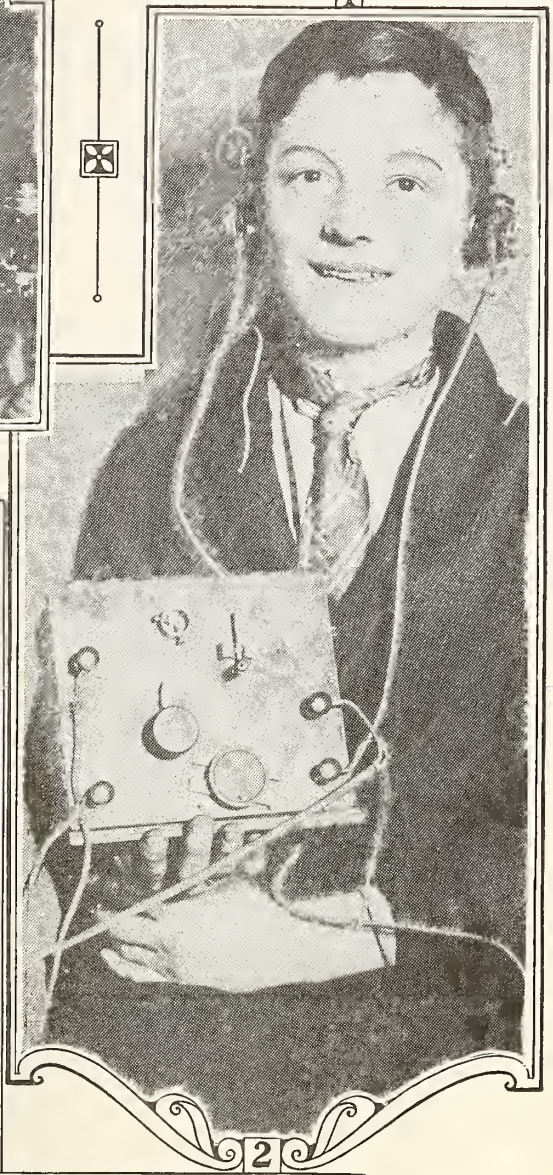

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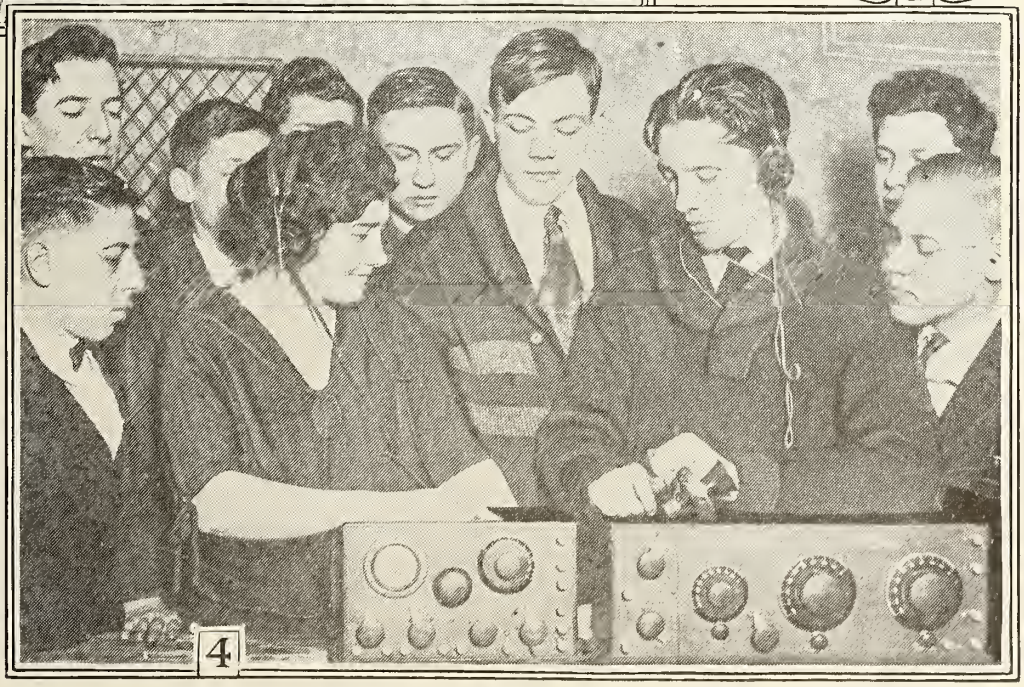

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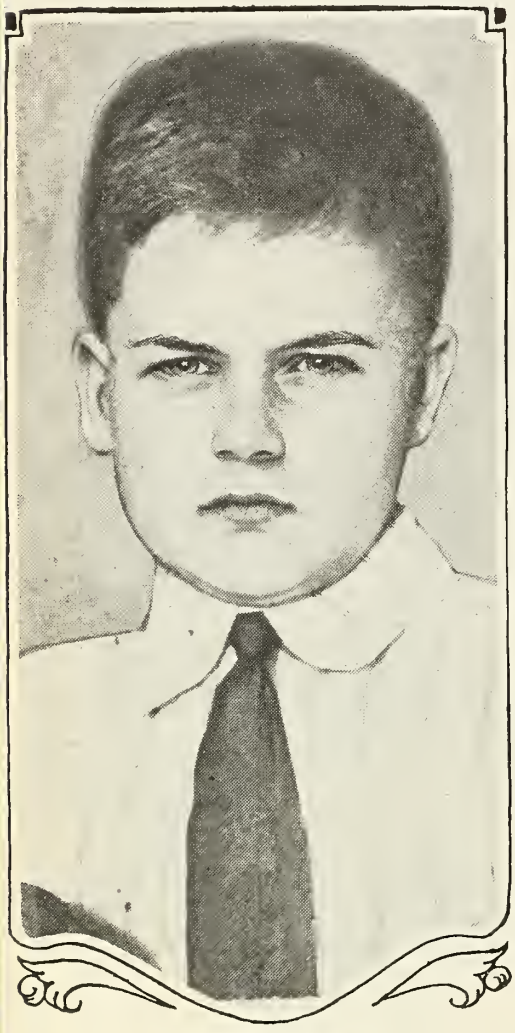
(1.) *Sergt. Lawrenee W. Bock no longer has "the loncsomest job in the army." He is the operator of the army radio station at Fort McPherson, Ga. The picture shows him enjoying songs by Galli Curci broadcast from Atlanta, Ga.* (2.) *Edward Herron, Chicago boy, showing one he made himself. Edward is proud of it and has a right to be.* (3.) *Chicago Boys' Club No. 2, 1725 Orehard St., has a radio class. Left to right, Georgc Hensel, Charles Coleman, Jr., Erwin Alanap and William Pour.* (4.) *Elizabeth A. Bergner, radio instructor at Lane Tcchnical High School, explaining to her class of boys some of the mysteries of Radio. Photos 2 and 3 by courtesy of*

Who's Who In Radio



"Paddy" O'Neill

IF WE were to follow a time-honored custom we would devote this page to men who are great and famous. Edison, Fleming, Marconi and De Forest, to be sure. All honor to these celebrities.

But the age of radio is essentially a new era for boys and the boys of today may be Steinmetzes tomorrow.

So our first Who's Who presents "Paddy" O'Neill and Eddie Neilsen. See Eddie's own story beginning on Page 5 and read about Paddy on this page. Send in your favorite boy radio "experts" for our Who's Who page.

Edwin Nielsen

ONE of the most enthusiastic boy radio fans in the Middle West is "Paddy" O'Neill, 11-year-old son of Detective Patriek J. O'Neill, who was killed by Tommy O'Connor, the Chicago gunman.

Little Pat, now the "man of the family," owns a cheap reeeiving set, which he has rigged himself, driving a pipe into the ground in his back yard to ground the wires. Driving in the pipe took a whole day of the boy's time.

As soon as his set was rigged and in operation, Pat called in all the neighbors to hear the Chicago Opera Company, hearing the same music as though he and his friends were in the front row at the Auditorium Theater—at $6 a seat.

The concerts are now a nightly feature in the O'Neill home. Detective O'Neill was killed when he and six other detectives went to the home of William Foley, O'Connor's brother-in law, to arrest him for the forfeiture of bonds in a charge of robbery. O'Connor dashed from the house, firing as he ran. O'Neill fell, dying on the way to the hospital.

Little Pat immediately took command of the family—his mother and three small brothers and sisters—acting for the grief-stricken woman in helping comrades of the slain policeman arrange a fitting funeral.

Through the generosity of Chicago citizens more than $10,000 was raised for the bereaved family.

Pat also wired their little home, and once tapped the service wires of the——but that's a secret.

RADIO AGE
"The Magazine of the Hour"
M. B. SMITH, PUBLISHER
PUBLISHED MONTHLY GARRICK BLD'G CHGO.
FREDERICK SMITH, EDITOR

Great Radio Shows To Come

THE Radio show at the Hotel Pennsylvania in New York set that city radio wild and greatly increased the interest in other shows to be given in the larger cities. Pittsburgh and Boston come first and then Chicago is to have two expositions, one in the Leiter Building, from June 26 to July 1, inclusive, and the other in the Coliseum during the week of October 15 to 21.

How you can send your morning kiss by radio to your wife while speeding over the rails on fast trains, how you can enjoy the great concerts of the country, listen in on vaudeville performances and hear the world news while seated comfortably in your home will be visualized by the displays at the National Radio Exposition to be held in the Leiter Building, Chicago, June 26th to July 1st, inclusive. Radio fans will be enabled to see every type of apparatus in operation at this show, where accessories by the gross will be exhibited and where numerous "stunts" will be put on to be broadeast throughout the middle west. This announcement was made by Milo E. Westbrooke, well known exposition manager, who recently staged the National Shoe Exposition in Chicago and who has put on some of the biggest trade shows in New York and Chicago. Mr. Westbrooke declared the Chicago Radio Exposition would be bigger and better than the one recently held in New York, where thousands upon thousands were turned away every night.

"This probably will be the most comprehensive Radio exposition ever conducted by, for and in the interest of radio fans," said Mr. Westbrooke. "There will be exhibits of every sort of radio apparatus manufactured, including the very latest devices and inventions. All the parts that are used in the construction of sending and receiving instruments will be on display.

"The working of the radiophone will be demonstrated and the people who have listened to concerts given hundreds of miles away and heard the world news transmitted to them while seated comfortably in their homes, will have an opportunity to see the instruments in operation and view the various parts utilized in their construction. The Radio Show in June will be one of the greatest educational expositions ever held in Chicago or any other city.

"The sudden popularity of radio telephony has resulted in the establishment of more than 600,000 receiving sets in the country, and of these 150,000 are located in the middle west. Throughout the United States 20,000 amateurs are qualified as transmitters, capable of sending and receiving a minimum of fifty characters a minute by transcontinental Morse code. For each Radiophone there is an average audience of five persons, thus making a total of 2,500,000 who are associated with the wonders of wireless."

The Sweet devotee of Radio carries a set in her hand bag.

The October Show

U. J. Herrmann, of the Cort Theater, announces that the "Annual Chicago Radio Show" will be given each year in October because deferring the exhibition to that season will give the manufacturers a chance to catch up with deliveries and will also permit them to complete and perfect many improvements in construction and design.

Mr. Herrmann says:

"Because of the enormous demand most manufacturers of radio equipment are months behind in filling orders. By October conditions should be greatly improved. The radio shows which have been held in other cities during the last year have been pronounced successes. In New York the public was turned away by the thousands every day during the show in the Pennsylvania hotel and the crowds were so great around the exhibits as to cause actual discomfort.

"The nation-wide, ever-growing interest in radio has amply demonstrated that only the largest exhibition buildings are adequate to properly handle the enormous crowds whose enthusiasm has placed radio shows on the plane with the big national automobile exhibits."

The Pittsburgh Show

Rare harmony from Chicago, musical comedy from Cleveland, trade conditions information from St. Louis, news flashes from New York, government reports from the National Capitol, these are only a few of the many features given via radio at the first Pittsburgh radio exhibition in the William Penn hotel, April 11, 12 and 13. A large receiving set erected by the Westinghouse interests receives and transmits these messages from the air for the benefit of the Pittsburgh fans and the numerous visiting delegations from the neighboring districts and states.

Practically every one of the largest manufacturers of radio equipment and supplies made reservation for the show but as space it limited at the William Penn a few could not be accommodated. Leading local dealers and distributors have extensive displays and their booths are both beautiful and educational. There are on exhibition sets of every one of the leading radio manufacturers as well as a large percentage of the battery and accessory people.

The educational talks and illustrated lectures are held throughout the afternoon and evening of each day of the show, except the opening date when the doors are open at 7 o'clock. These lectures are conducted by men prominent in the industry and are intended to both instruct the fans as to the proper means of assembling their equipment and to educate the uninitiated in to the mysteries of the wireless.

Turn to page Thirteen

Tune Up and Listen In

Broadcasting from these Stations is on 360 meters where not otherwise specified

Midwest Broadcasts

Eighth District

WDKA—Westinghouse Electric & Mfg. Co., Pittsburgh, Pa. Daily, except Sunday, music 10:00-10:15 a. m. and 12:30-1:00, 2:00-2:20 and 4:00-4:20 p. m., with special Saturday concert 3:00-4:00 p. m.; bedtime stories, 7:30 p. m.; press, 7:45; special features and vaudeville acts, 8:00 p. m.; music and news, 8:30-9:30; Sunday, church service, 10:45 a. m., 3:00 p. m. and 7:30 p. m.

WBL—The Detroit News, 615 Lafayette Bldg., Detroit, Mich. Daily, except Sunday, 11:30-11:55 a. m., and 3:30-4:00 p. m., phonograph music; 7:00-8:30 p. m., special musical programs by selected artists.

KQV—Doubleday-Hill Electric Co., 719 Liberty Ave., Pittsburgh, Pa. Daily except Saturday and Sunday, music, 4:30-5:00 p. m.; Sunday, 1:00-1:30 p. m. and 4:00 to 5 p. m.; Monday, Wednesday and Friday, 9:30 to 10:30 p. m.

WDZ—Marshall Gerken Co., 27 Ontario Ave., Toledo, Ohio.

WPB—Pittsburgh Gazette-Times, Gazette Square, Pittsburgh, Pa.

WMH—Precision Equipment Co., Cincinnati, Ohio. Monday, Wednesday and Saturday, 8:15-10:00 p. m., music, speeches and news; daily 485 meters; 11:00 a. m. and 4:00 p. m., weather reports.

Ninth District

WOV—R. B. Howell, 1802 Farnum St., Omaha, Neb.

WHA—University of Wisconsin, Madison, Wis. Daily except Sunday, weather reports at 12:35 p. m., Friday at 8:15 p. m.; special music and other dates as announced. Midnight to 1:00 a. m., university news on 410 meters.

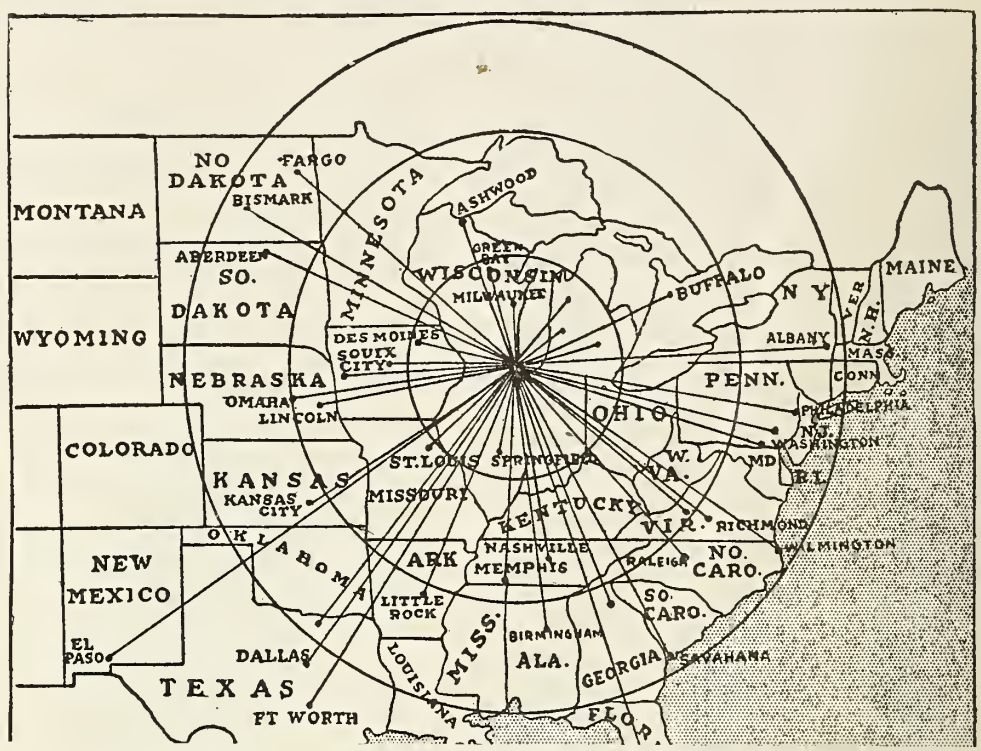
WLB—University of Minnesota, Minneapolis, Minn. 485 meters; daily 12 noon, weather and stock reports; 7:30 p. m., wheat and potato market; 7:45 p. m. Wednesday only, music, 360 meters.

WLK—Hamilton Mfg. Co., 2011 North Alabama St., Indianapolis, Ind., Sunday, 8:00-8:55, religious, vocal and instrumental music; Tuesday, 8:00-8:55 p. m., jazz, vocal and instrumental music; 9:00-10:00 p. m., local theatre numbers and news items; Thursday, 8:00-8:55, special numbers from local singers and orchestras, stories, news and speeches.

KYW—Westinghouse Electric & Mfg. Co., 111 W. Washington St., Chicago, Ill. Daily, except Sunday, 9:30, 10:00, 10:30, 11:30, and 12:00 a. m. and 2:45 p. m., stock and market reports; 2:15, 4:15 and 6:00 p. m., news and market reports; 7:00 p. m., summary of financial report; 7:30 p. m., children's bedtime story; 8:00-9:00 p. m., musical program; 9:00 p. m., news and sports; Sunday, 3:30 p. m., Radio Chapel.

WXAB—Western Radio Co., Kansas City, Mo. Market reports and weather forecast, 11:30 a. m. and 2:30 p. m.; concerts in the evening.

WZAF—Reynolds Radio Co., Denver, Colo. News twice daily and concert Sunday evening.



List of stations broadcasting market or weather reports (485 meters) and music, concerts, lectures, etc. (360 meters), (March 10, 1922).

Owner of station.	Location of Station	Wave lengths.	Call Signal.
Allen, Preston D.	Oakland, Calif.	360	KZM.
American Radio & Research Corp.	Medford Hillside, Mass.	360	WGI.
Atlantic-Pacific Radio Supplies Co.	Oakland, Calif.	360	KZY.
Bamberger, L., & Co.	Newark, N. J.	360	WCR.
Bible Institute of Los Angeles, Inc.	Los Angeles, Calif.	360	KJS.
Church of the Covenant	Washington, D. C.	360	WDM.
City of Chicago	Chicago, Ill.	360	WBU.
Cox, Warren R.	Cleveland, Ohio	360	WHK.
Crosley Mfg. Co.	Cincinnati, Ohio	360	WLW.
DeForest Radio Telep. & Teleg. Co.	New York, N. Y.	360	WJX.
Detroit News, The	Detroit, Mich.	360, 485	WWJ.
Doubleday-Hill Electric Co.	Pittsburgh, Pa.	360	KQV.
Doron Brothers Electric Co.	Hamilton, Ohio	360	WRK.
Duck Co., Wm. B.	Toledo, Ohio	360	WHU.
Dunn & Co., J. J.	Pasadena, Calif.	360	KLB.
Electric Lighting & Supply Co.	Hollywood, Calif.	360	KGC.
Examiner Printing Co., The	San Francisco, Calif.	360	KUO.
General Electric Co.	Schenectady, N. Y.	360	WGY.
Gilbert Co., A. C.	New Haven, Conn.	360	WCJ.
Gould, C. O.	Stockton, Calif.	360	KJQ.
Hamilton Mfg. Co.	Indianapolis, Ind.	360	WLK.
Hatfield Electric Co.	Indianapolis, Ind.	360	WOH.
Herrold, Chas. D.	San Jose, Calif.	360	KQW.
Hobrecht, J. C.	Sacramento, Calif.	360	KVQ.
Howlett, Thos. F. J.	Philadelphia, Pa.	360	WGL.
Karlowa Radio Co.	Rock Island, Ill.	360, 485	WOC.
Kennedy, Colin B. Co.	Los Altos, Calif.	360	KLP.
Kluge, Arno A.	Los Angeles, Calif.	360	KQL.
Kraft, Vincent I.	Seattle, Wash.	360	KJR.
Lorden, Edwin L.	San Francisco, Calif.	360	KGB.
Marshall-Gerken Co.	Toledo, Ohio	360, 485	WSZ.
Metropolitan Utilities District	Omaha, Nebr.	360, 485	WOU.
Meyberg Co., Leo J.	San Francisco, Calif.	360	KDN.
Meyberg Co., Leo J.	Los Angeles, Calif.	360	KYJ.
Missouri State Marketing Bureau	Jefferson City, Mo.	485	WOS.
Montgomery Light & Water Power Co.	Montgomery, Ala.	360, 485	WGH.
Newspaper Printing Co.	Pittsburgh, Pa.	360	WPB.
Northern Radio & Electric Co.	Seattle, Wash.	360	KFC.
Palladium Printing Co.	Richmond, Ind.	360, 485	WOZ.
Pine Bluff Co., The	Pine Bluff, Ark.	360	WOK.
Pomona Fixture & Wiring Co.	Pomona, Calif.	360	KGF.
Portable Wireless Telephone Co.	Stockton, Calif.	360	KWG.
Precision Equipment Co.	Cincinnati, Ohio	360, 485	WMH.
Precision Shop, The	Gridley, Calif.	360	KFU.
Radio Construction & Electric Co.	Washington, D. C.	360	WDW.
Radio Corporation of America	Roselle Park, N. J.	360	WDY.
Radio Shop, The	Sunnyvale, Calif.	360	KJJ.
Radio Telephone Shop, The	San Francisco, Calif.	360	KYY.
Reynolds Radio Co.	Denver, Colo.	360, 485	KIZ.
Rike Kumler Co., The	Dayton, Ohio	360, 485	WFO.
Rochester Times Union	Rochester, N. Y.	360, 485	WHQ.
Seeley, Stuart W.	East Lansing, Mich.	485	WHW.
Service Radio Equipment Co.	Toledo, Ohio	360	WJK.
Ship Owners Radio Service	New York, N. Y.	360	WDT.
Union College	Schenectady, N. Y.	360	WRL.
University of Minnesota	Minneapolis, Minn.	360, 485	WLB.
University of Wisconsin	Madison, Wis.	360, 485	WHA.
Warner Bros.	Oakland, Calif.	360	KLS.
Wasmer, Louis	Seattle Wash.	360	KHQ.
Westinghouse Electric & Mfg. Co.	Springfield, Mass.	360	WBZ.
Westinghouse Electric & Mfg. Co.	Chicago, Ill.	360	KYW.
Westinghouse Electric & Mfg. Co.	Newark, N. J.	360	WJZ.
Westinghouse Electric & Mfg. Co.	East Pittsburgh, Pa.	360	KDKA.
Western Radio Electric Co.	Los Angeles, Calif.	360	KOG.
Western Radio Co.	Kansas City, Mo.	360, 485	WOQ.
White & Boyer	Washington, D. C.	360	WJH.
[illegible]	Jersey City, N. J.	360	WNO.

Boy Tells How To Make 'Em

By EDWIN NIELSEN

(16 years of age)

EDWIN NIELSEN is a Chicago boy who works for a big newspaper at night and makes receiving sets and experiments with them when he gets a chance. His article is brief but if there are points needing more detailed explanation inquiries may be addressed to him in care of the Radio Age. Send self addressed and stamped envelope to Edwin Nielsen, Care Radio Age, 1311 Garrick Building.

The Editor.

THERE are now about 80 radio stations in the United States, that are sending out news reports, market reports, opera and musical concerts, EVERY DAY. All of this broad casting may be received by ANYONE who wishes to listen to it. It can be received on outfits that are almost entirely homemade, and are so simple that they can be made by even the unskilled worker, though with a set of the kind I have in mind, the beginner must not expect to receive from any very great distances, as it will not receive messages from over 50 miles.

With receiving outfits at such a low price, there ought to be a set in every home, even if it be the simplest set that was ever devised.

A radio outfit is usually composed of an aerial system to catch the waves that are sent out by the sending station, a ground system to catch the waves that come from the ground through which they travel as well as through the air, a tuning system to allow the operator to listen to any single sending station so that he does not hear merely a jumble of sounds, a detector system which changes the radio waves to electro-magnetic waves or waves which will act upon the magnets in the telephones and produce sounds, and in the new sets a condenser system to make the sounds clearer and louder.

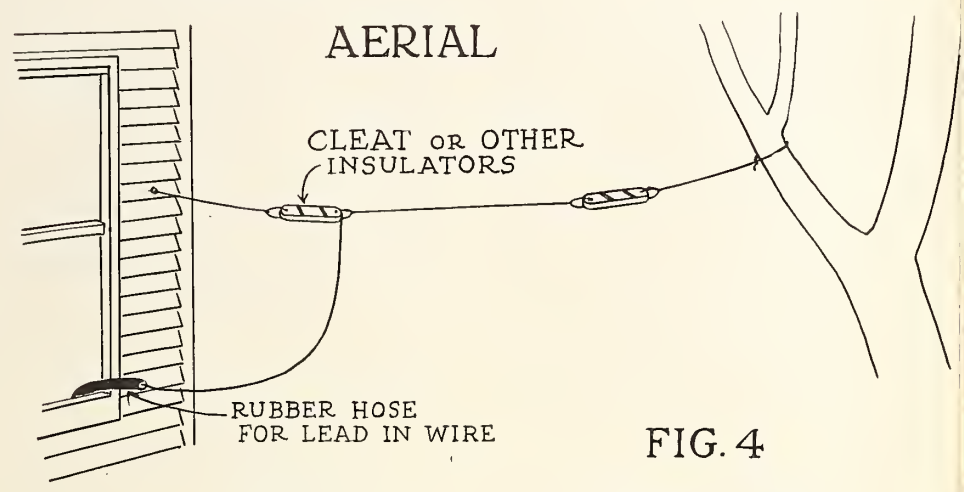


FIG. 4

HOW TO CONNECT THE INSTRUMENTS

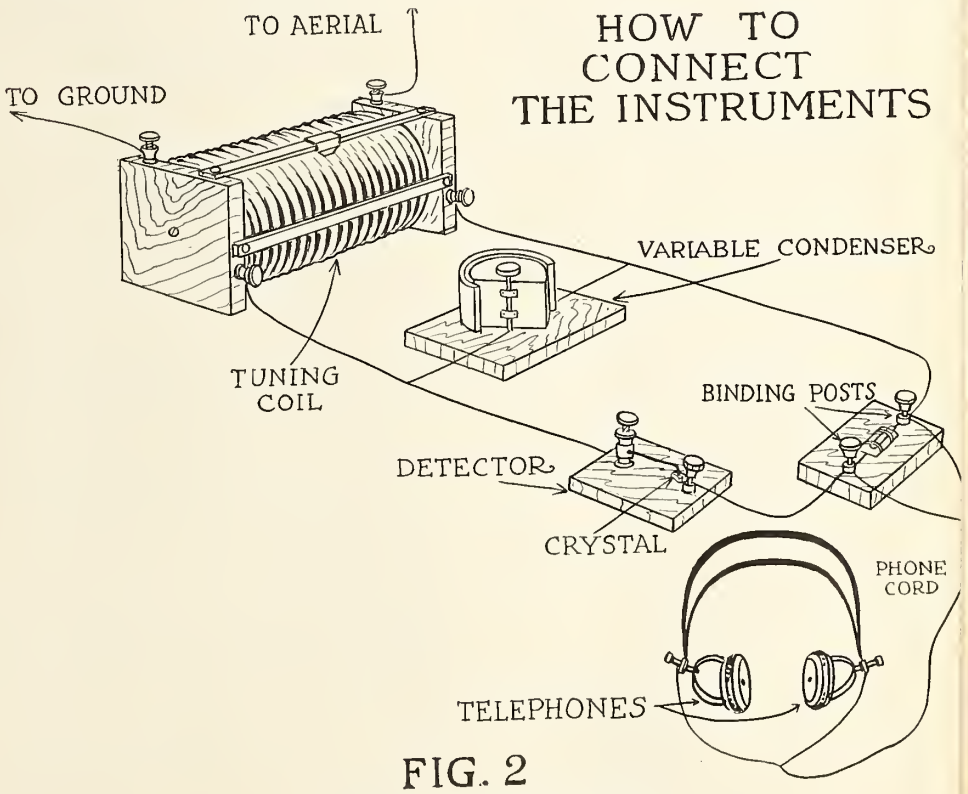


FIG. 2

Figure 1 on following page

A receiver that would work well especially for the Radiophone concerts would be composed of: 1st, a tuning coil; 2nd, a condenser, preferably of the Variable type; 3rd, a crystal detector; 4th, a small fixed condenser; and 5th, and last, a pair of receiving telephones.

The tuning coil is what is known as a two slide tuning coil and is made of a cardboard tube, wound with about 250 turns of No. 22 wire. The tube is then fastened to two square pieces of wood, which has two copper or brass rods, about one-fourth inch square, fastened to it. Two sliders are then made of brass bent to fit around the square rod and soldered at the place indicated in Figure 1.

the rods, keeping contact with the wire, and enable the operator to tune in different stations till the desired station is clearly heard.

In figure 1, "A," is the cardboard tube. "B" shows the round wooden discs which fit inside the tube and allow the tube to be firmly fastened to the square blocks, "C" which holds the whole coil in an upright position so that it can be operated readily. "D" shows the method of making the sliders. In figure 2, the complete coil may be seen with both sliders shown, and all instruments in place.

The variable condenser can be made of a semi-circular piece of wood cut according to the directions in figure 3. There are good variable condensers

where from 3 to 65 plates. They wi improve any set, as about 60% of th tuning is done by a variable condense A fixed condenser can be made of thr sheets of tinfoil separated by mic sheets. The middle sheet of tinfoil mu protrude at one end of the mica ar must not come in contact with the oth sheets of tinfoil. The whole condens is held together with rubber bands ar wires are fastened to the protrudi edges of the tinfoil.

The detector can be made with tw binding posts, a piece of stiff wire, hai pin, or pin, and a piece of Galena cry tal. The binding posts are fastened a wood base about an inch and a ha apart, the crystal fastened to one them, the wire fastened to the oth

Boy Tells How To Make a Home Set

Continued form page five

nd the point of the wire resting on the rystal. The instruments are then con-ected as indicated in Fig. 2.

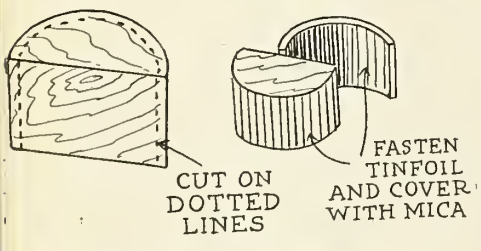
The aerial can be of any one of the ıany types illustrated but a single ne of 14 gauge wire from 75 to 100 eet in length well insulated will work s good if not better than the others. y good insulation I mean that the ire must not touch anything except orcelain, glass, rubber or other sub-tance that will NOT conduct elec-ricity. Fig 4 shows a single wire erial with the insulators in place. The round wire must be fastened to a ater pipe or gas pipe, or any other ipe that goes beneath the surface of ıe ground.

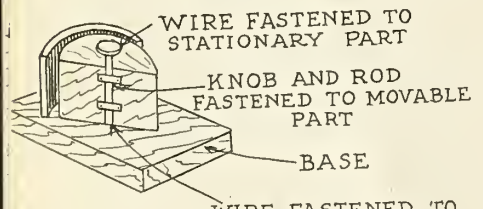
The most important instruments now eeded are the telephones, and as they annot be made, they must be bought nd as the best instruments are of little r no use unless the telephones are good, would suggest that they be a good air that you will not have to discard ven when you get an expensive outfit.

To operate the set after you have verything connected you have to move he sliders of the tuning coil till you et the station you wish to hear, as oud as you can get it, then the mov-ble part of the condenser is turned ack and forth until the signals come learest.

If you do not get results, the crystal etector is the probable cause, and the ire must be made to touch the crys-l in different places, in search of a ensitive spot where the signals can be eard. If this does not work the crys-l must be discarded and one that is ıore sensitive purchased.

VARIABLE CONDENSER





SMALL FIXED CONDENSER

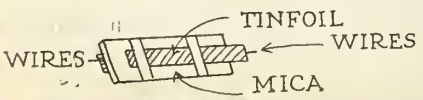
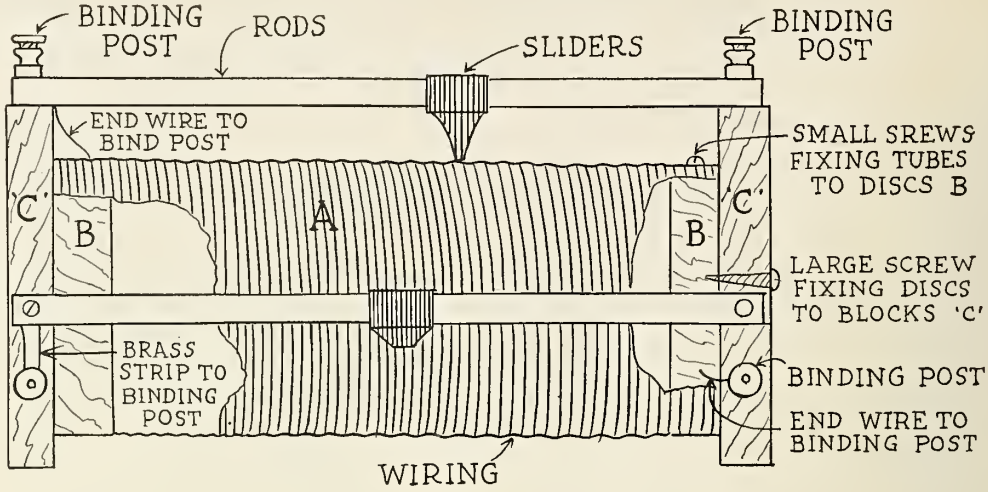
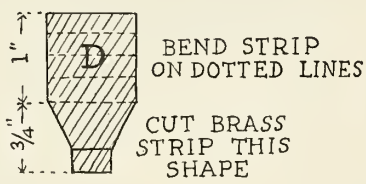


FIG. 3





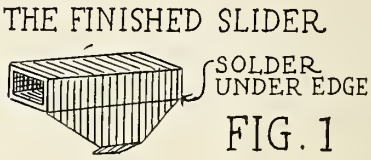


FIG. 1

Radio on the Farm

Neither the telephone nor the automobile made so great an advancement in the farmer's contact with the village and the city as the radiophone is doing. Farmer boys, quick to seize upon the radio receiving set as a scientific mystery that must be mastered, have brought the rural districts into close association with one another and with the life of the big cities. The result is not only entertaining but it is decidedly useful.

An eastern inventor says he will make a plow which can be directed by radio. Many of these dreams may come true but there are other developments in radio that engage the practical farmer in the practical present. For example, there is the plan of the Chicago Board of Trade to establish a radio system of crop and produce reports and market quotations which will be heard throughout a radius of 500 miles from Chicago.

W. A. Wheeler, of the United States Department of Agriculture, says there is no single use of radio, except for marine and aerial purposes, that should take precedence over its utilization for the benefit of agriculture.

"There are more than 32,000,000 farmers," said Mr. Wheeler, "nearly one-third of the population of the United States. Radio is the only means of getting to them quickly and at small cost. The time element in dispatching weather predictions to the farmer is a big factor. In cutting hay or harvesting grain an hour's delay in receiving a weather report may mean a loss of solve the problem."

As in the city it is the boy who is leading the march toward the perfected radio age in the country. In Ocean Grove, N. J., a group of boys who were interested in radio, pooled their knowledge of the science and co-operated in a financial way to establish a radio receiving station, from which they send out telephone calls and messengers with the latest reports on weather, the markets and the crop situation. This club, known as the Ocean County Radio Club, has become so popular that boys in other counties and other states are following the Jersey example. This has attracted the active interest of many agricultural colleges.

The St. Louis University is broadcasting national and local agricultural reports. The United States Department of Agriculture broadcasts this service from stations at Cincinnati, Omaha, Washington, North Platte, Neb., Rock Springs, Wyo., Elko and Reno, Nevada. These are received by thousands of state bureaus, agricultural associations, banks and other interests which relay them to individual farmers.

The official weather prophet in England sends out warning of approaching thunderstorms by radio and a charge is made of six cents per message.

The Farm Bureau Federation of Chicago announces plans to complete its service of sending out by radio market figures, reports and activities of the American Farm Bureau, The United States Grain Growers, the Illinois Agricultural Association and the National

How To Make A Radio Set For $6

A WIRELESS LESSON BY UNCLE SAM HIMSELF

"HOW can I make a radiophone receiving outfit for a small price and listen in on the concerts, speeches, news reports, weather forecasts, etc., that are broadcast each night from the sending stations nearest my home? I know very little about electricity but thousands of novices are making their own radio sets and I want to make one, too. I do not understand the long words used in most explanations. I want somebody to tell me in simple language, with clear diagrams, just how it can be done."

One of the main objects in starting Radio Age is to answer in this first issue, and in all succeeding issues, the foregoing question—a question asked by hundreds of thousands of boys and their daddies.

Proof that the government is impressed with the necessity for helping radio beginners is supplied in the following article. So many boys and girls in radio clubs wanted the information that the States Relations Service of the U. S. Department of Agriculture asked the U. S. Bureau of Standards to prepare the article for beginners. If all points are not made clear send stamped envelope with request for explanation and Radio Age will give you the desired information.

The Editor.

THIS artiele tells how to eonstruet the entire receiving station, including antenna as well as a erystal-detector reeeiving set. This station will enable one to hear the messages sent from medium-power transmitting stations within an area about the size of a large eity, and to hear high-power stations within 50 miles, provided the waves used by those stations have wave frequeneies between 500 and 1500 kilocycles per seeond (i. e., wave lengths between 600 and 200 meters). Much greater distances are often eovered, especially at night. If a person eonstructs the coil and other parts as indicated, the total eost of this set ean be kept down to about $6.00. If, however, a speeially efficient outfit is desired, the eost may be about $15.00.

Essential Parts

There are five essential parts: the antenna, lightning switch, ground eonneetions, reeeiving set, and phone. The reeeived signals eome into the receiving set through the antenna and ground connection. In the reeeiving set they are eonverted into an eleetrie eurrent which produces the sound in the "phone." The phone is either one or a pair of telephone reeeivers worn on the head of the listener.

The purpose of the lightning switch is to proteet the reeeiving set from damage by lightning. It is used to connect the antenna directly to ground when the receiving station is not being used. When the antenna and the connection to the ground are properly made and the lightning switeh is elosed, an antenna acts as a lightning rod and is a proteetion rather than a souree of danger to the building.

The prineipal part of the station is the "reeeiving set." In the set deseribed herein it is subdivided into two parts, the "tuner" and the "detector," and in more eomplicated sets still other elements are added.

Antenna

The antenna is simply a wire suspended between two elevated points. Wherever there are two buildings, or a house and a tree, or two trees with one of them very close to the house, it relieves one of the need of ereeting one or both antenna supports. The antenna should not be less than 30 feet above the ground and its length should be about 75 ft. (See Fig. 1.) While this figure indicates a horizontal antenna, it is not important that it be strietly horizontal. It is in faet desirable to have the far end as high as possible. The "lead-in" wire or drop-wire from the antenna itself should run as directly as possible to the lightning switch. If the position of the adjoining buildings or trees is sueh that the distance between them is greater than about 85 ft., the antenna can still be held to a 75 ft. distance between the insulators by increasing the length of the pieee of rope (D) to whieh the far end of the antenna is attaehed. The rope (H) tieing the antenna insulator to the house should not be lengthened to overcome this difficulty because by so doing the antenna "lead-in" or drop-wire (J) would be lengthened.

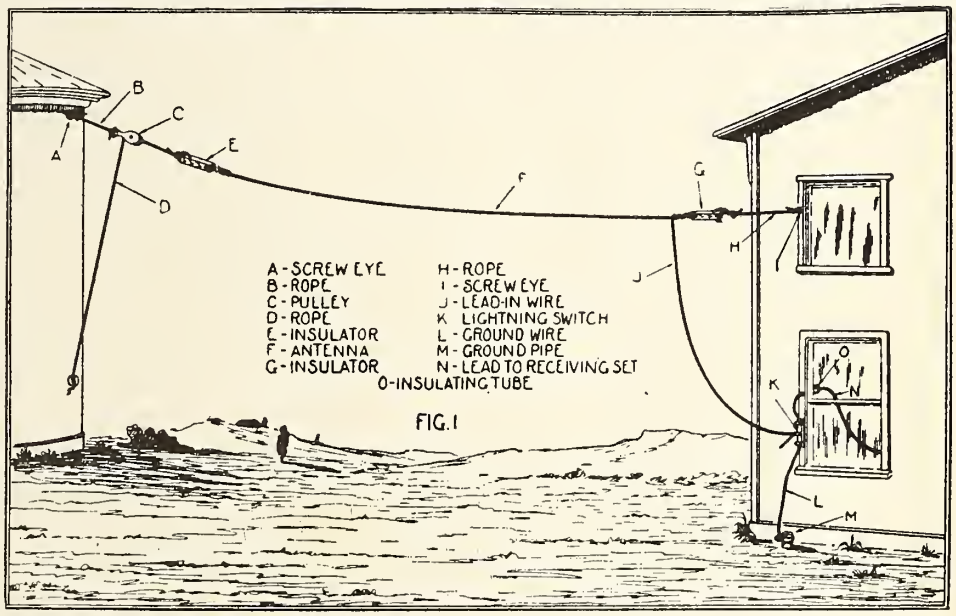


FIG. 1

J - LEAD-IN WIRE
K LIGHTNING SWITCH
L - GROUND WIRE
N - LEAD TO RECEIVING SET
O - INSULATING TUBE
P - RECEIVING SET
Q GROUND FOR RECEIVING SET

FIG. 2

Details of Parts.—The parts will be mentioned here by reference to the letters appearing in Figs. 1 and 2.

A and I are screw eyes suffieiently strong to anchor the antenna at the ends.

B and H are pieees of rope ⅜ or ½ inch in diameter, just long enough to allow the antenna to swing elear of the two supports.

D is a pieee of ⅜ or ½ inch rope sufficiently long to make the distance between E and G about 75 ft.

C is a single-bloek pulley whieh may be used if readily available.

Insulators

E and G are two insulators whiel may be eonstrueted of any dry hard wood of sufficient strength to withstand the strain of the antenna; bloeks about 1½x2x10 in. will serve. The hole should be drilled as shown in Fig. 1 suf

Continued on page 8, column 1

How to Make a Radio Set for $6

Continued from page seven

ficiently far from the ends to give proper strength. If wood is used the insulators should be boiled in paraffin for about 1 hour. If porcelain wiring cleats are available they may be substituted instead of the wood insulators. If any unglazed porcelain is used as insulators, it should be boiled in paraffin the same as the wood. Regular antenna insulators are advertised on the market, but the two improvised types just mentioned will be satisfactory for an amateur receiving antenna.

F is the antenna about 75 ft. between the insulators E and G. The wire may be No. 14 or 16 copper wire either bare or insulated. The end of the antenna farthest from the receiving set may be secured to the insulator (E) by any satisfactory method, being careful not to kink the wire. Draw the other end of the antenna wire through the other insulator (G) to a point where the two insulators are separated by about 75 ft., twist the insulator (G) so as to form an anchor as shown in Fig. 1. The remainder of the antenna wire (J) which now constitutes the "lead-in" or drop-wire should be just long enough to reach the lightning switch.

Lightning Switch

K is the lightning switch. For the purpose of a small antenna this switch may be the ordinary porcelain-base, 30 ampere, single-pole double-throw battery switch. These switches as ordinarily available, have a porcelain base about 1 by 4 in. The "lead-in" wire (J) is attached to this switch at the middle point. The switch blade should always be thrown to the lower clip when the receiving set is not actually being used and to the upper clip when it is desired to receive signals.

L is the ground wire for the lightning switch; it may be a piece of the same size wire as used in the antenna, of sufficient length to reach from the lower clip of the lightning switch (K) to the clamp on the ground rod (M).

M is a piece of iron pipe or rod driven 3 to 6 ft. into the ground, preferably where the ground is moist, and extending a sufficient distance above the ground in order that the ground clamp may be fastened to it. Scrape the rust or paint from the pipe before driving in the ground.

N is a wire leading from the upper clip of the lightning switch through the porcelain tube (O) to the receiving set binding post marked "antenna."

O is a porcelain tube of sufficient length to reach through the window casing or wall. This tube should be mounted in the casing or wall so that it slopes down toward the outside of the building. This is done to keep the rain from following the tube through the wall to the interior.

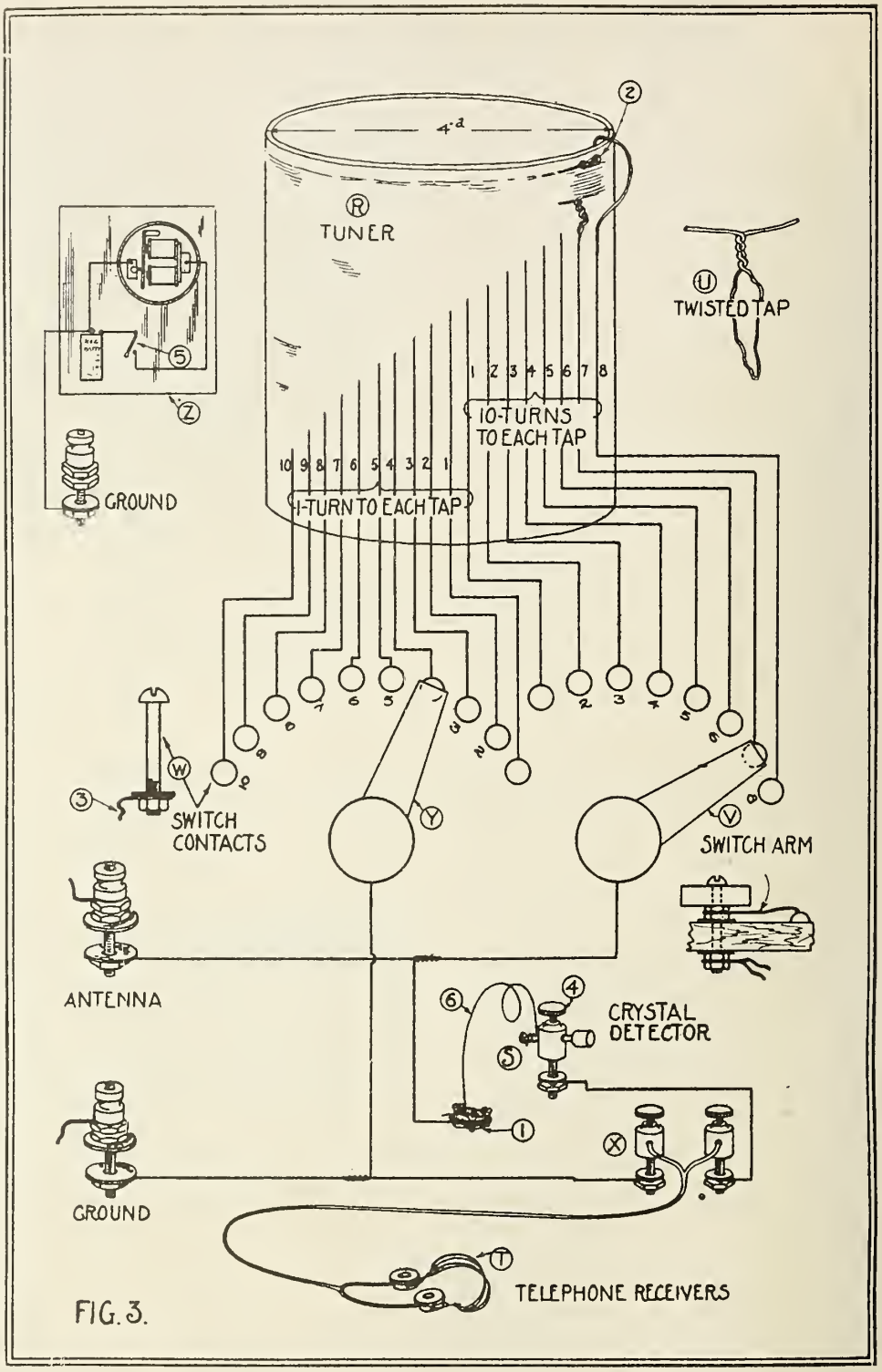


FIG. 3.

Ground Wire

Fig. 2 shows the radio receiving set installed in some part of the house.

P is the receiving set which is described in detail below.

N is the wire leading from the "antenna" binding post of the receiving set through the porcelain tube to the upper clip of the lightning switch. This wire, as well as the wire shown by Q, should be insulated and preferably flexible. A piece of ordinary lamp cord might be unbraided and serve for these two leads.

Q is a piece of flexible wire leading from the receiving set binding post marked "ground" to a water pipe, heating system or some other metallic conductor to ground, except M, Fig. 1. If there are no water pipes nor radiators in the room in which the receiving set is located, the wire should be run out of doors and connected to a special "ground" below the window, which shall not be the same as the "ground" for the lightning switch. It is essential that for the best operation of the receiving set this "ground" be of the very best type. If the soil near the house is dry it is necessary to drive one or more pipes or rods sufficiently deep to encounter moist earth and connect the ground wire to the pipes or rods. This distance will ordinarily not exceed 6 ft. Where clay soil is encountered this distance may be reduced to 3 ft., while

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New Radio Trade Features

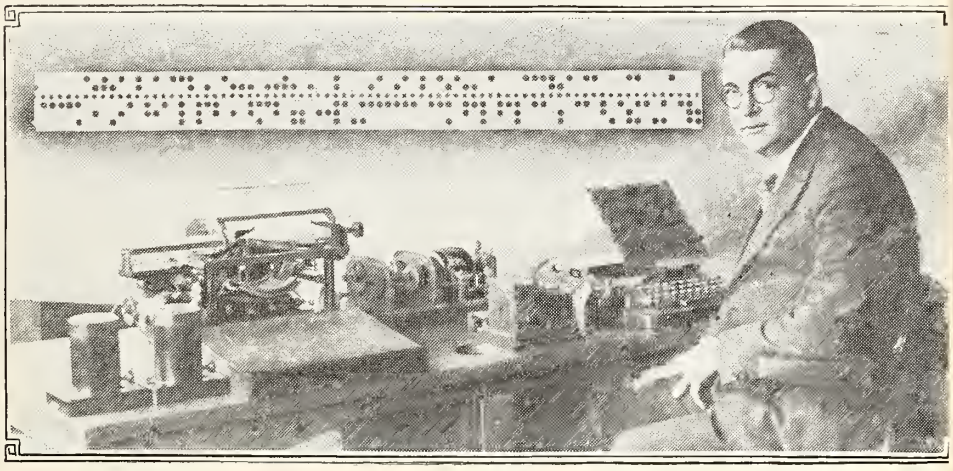
IT is expressing it conservatively to say that every day there is some new and interesting development in radio operation, radio utility or in radio invention. Some of the novelties are more interesting than important.

But others are beacon lights showing the way to perfection in radio uses that were unhoped for a comparatively short time ago. We present two radio devices which should interest not only the radio trade generally but the many thousands of individuals who are following with amazement the progress of the sound-wave in its silent attack on a lot of our old ideas and customs.

With the ordinary receiving set you have several instruments scattered about a table with wires connecting the different parts. The designer of the Simplex Radiola, J. H. Newman, encloses all these parts in a fine cabinet similar to a phonograph cabinet, a real piece of furniture. The set is complete for receiving any telephone or telegraph messages within a radius of 1000 miles of the sending station.

The features of this machine are: an auxiliary panel with switches for the batteries and horn, rheostat for reducing the volume of sound and also increasing it, etc. Two drawers are provided for writing materials, extra headphones, books and any other materials used.

This machine has been operated in hotel lobbies and before audiences in theatres with tremendous success.

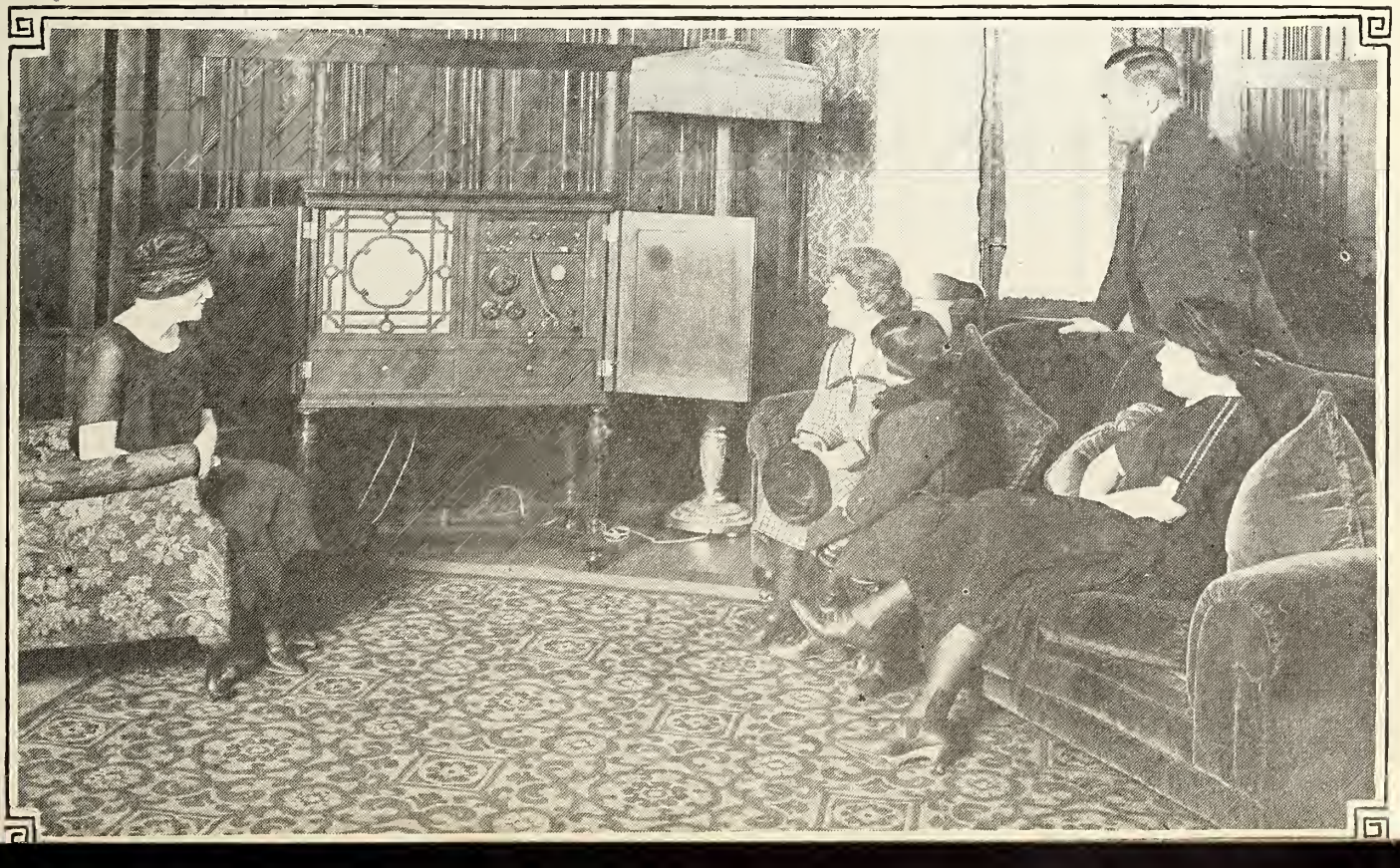


Secrecy in wireless communication may be obtained by the adoption of printing telegraph machines similar to those used on press and commercial telegraph circuits in many parts of the country. Experiments have been under way by the Morkrum Company for months with automatic wireless printers and the system has proved successful.

The printing machines use a tape in which a punching machanism, operated by the keys of a typewriter keyboard, perforates holes in various combinations of five positions. This tape by means of an automatic transmitter and rotary switch, controls the grid circuit of a c. w. transmitting set and sends interrupted c. w. signals. At the receiving station, the Radio signals are received in a sensitive receiving s and in place of the telephones, a sp cially designed relay is connected in the circuit. This relay in turn co trals a rotary switch, which operat five magnets in the receiving pa printer and sets up the combinatic which corresponds to the one tran mitted from the perforated tape at tl transmitting station.

Secrecy is attained because code cor binations can be varied at will and tl rotary switches at transmitting and r ceiving stations must also be synchro ized and the speed of these two switch can be varied.

Further information about the Rac cla and the Radiotype will be furnishe by Radio Age on request.



Questions and Answers

Under this heading Radio Age will publish questions and answers each month. The answers will be written by efficient chnicians. Readers should limit themselves to five questions in each letter. It is preferable that they should write on one de of the page only and use special care to make their name and address readable.

F. E. C. Elmwood—Kindly let me now what I would need and the conruction of a loud speaker (magnavox yle), suitable for a set equipped with loose coupler, A. P. detector and two age radiotron amplifier.

Answer—It is not practical to make home-made magnavox receiver. A oud speaker may be made by coupling single sensitive receiver, such as the aldwin or Browne, to a horn or to our phonograph. You can purchase coupling device that is made for the urpose.

E. K. encloses a standard hetrodyne ook-up that is coupled to the secondry of an audion receiver and asks:

1. The size of each coil (five altoether) to receive P. O. Z.

2. Is there any advantage in using 10 volts on the oscillator through a lter?

3. Is an A. P. amplifier suitable for ıe oscillator and a W. E.-V. T. 1 as ıe detector?

Answer—1. Use two 1,000-turn coils or primary and secondary, with some nall coil of such as 25 turns to couple he hetrodyne. The hetrodyne may ave two 750-turn coils. You probably ould get better results using an rmstrong hook-up with the other bulb s a step of amplification.

2. There is no advantage. It might ork, however. The Navy tried this unt some time ago, but has discardd it.

3. The tubes you mention are exellent for the purpose. Use 45 volts r more for the plate.

J. B. says: I am using one of the nall crystal sets that are so popular, nd I would like to know if there is ny simple way of increasing my overll efficiency.

Answer—The aerial and ground are he logical place to start. See that our antenna is kept far away from in roofs, trees, chimneys or any obects that may steal energy. Solder ll connections, increase your antenna nd lead-in insulation. Connect your round lead to gas and water pipes, adiators and any other grounded obects about the station. Try out several different crystals. When you find really sensitive detector you will ave improved matters immensely.

T. H.—I just moved from the country here I had a 100-foot aerial which I sed in conjunction with a receiving nstrument having two steps of amplication. The owner of the house I now ve in has refused me permission to rect any aerial. I tried a loop, but ith very little success. What can I dd to the set to make the loop recep-

Answer—A larger loop may help you. Failing, we suggest that you add another step to your detector and another to your amplifier. This will give you the desired results.

Q. X.—My aerial is 55 feet long and 30 feet high. Can this be improved upon?

Answer—Yes. Run your aerial out to as near 100 feet as you can. The height is all right providing there is no immediate object which towers over or flanks it.

M. B. says: A friend of mine wants to hook in his set on my aerial. He lives in another house. Do you think that two sets operating from the same aerial will give good results to both of us? If not, can we run another aerial parallel to the one I am using without causing interference to each other?

Answer—Two sets cannot be operated from the same aerial at the same time. If you refer to receiving set there will be no interferenc from either of the two parallel aerials. On the other hand, however, if you have transmitting set there is a merry time in store for both of you, with all the interference on earth for both of you while trying to operate at the same time especially if one of you is trying to receive.

C. E. R. says: I have a loose coupler and audion detector, singing does not come in plain, however the announcer's voice comes in plain. Is there any way in which I can make singing come in plain? (b) Can I make this outfit louder without using any additional apparatus? (c) My aerial is 75 feet long, 30 feet high at one end and 20 feet high at the other, would it improve conditions if I were to make it 100 feet long? (d) Does it weaken the B battery to have it connected? (e) Does it dim the signals when there is a splice in the lead-in about two feet from instruments?

Answer (a) The only way we can answer this is to tell you that the announcer is an exceptionally good, clear, distinct and forceful speaker at Station KYW. (b) The only way we could determine how you could do this is to examine your hookup, mail us a copy of your hookup, and we may be able to give you some help. (c) Yes, this would be an improvement, however, we would suggest that you raise your aerial a few more feet. (d) We would have to see your hookup before answering this question. (e) If you have the connection soldered it will be perfectly satisfactory, and will not decrease sig-

W. B. encloses copy of hookup and asks (a) What is the approximate wave length of my set? (b) Could you suggest any improvement which might improve this set? (c) Are values of grid leak and condenser correct or would you suggest a change?

Answer (a) Your approximate wave length is 800 meters. (b) The only change we could suggest is, make your B battery variable, we think that you might possibly get better results using less voltage on your detector. (c) We think you are using the correct capacity for grid condenser, however, you should employ a variable grid leak, as different tubes and conditions require different values of leakage across the condenser, a variable condenser at this point would also be very desirable. However, you can determine the value required at this point, and then make a fixed condenser of the correct value, which will be satisfactory.

B. J.: A receiving set could be made to fit in a cigar box. Wind the tuning coil on a block of wood instead of a cylinder. The other pieces do not take up much room.

F. S.: Lester Hart of Rockville Centre, L. I., is using a home-made variometer regenerative receiver, and has copied practically all of the distant phones. The secret seems to be that he is using one of the old audiotron tubes that are remarkably sensitive. His B battery is made up of flashlight cells, which he claims work better than the usual block battery. One peculiarity in his circuit is that he uses no grid-leak. This works fine with some tubes. It must be remembered that grid-leaks were unknown in the early days of the vacuum tube.

A. B. C.: Many people going into the radio game start with a small tuning coil and crystal detector, then eventually someone will talk to them about building a big set. This immediately creates the impression that if they construct a tuning coil about five times as large that they will hear better. In this they are mistaken. The only thing this does is increase the wave length of the instrument, and does not increase the loudness or efficiency of the set. Get just as much wire on the coil as is necessary and then stop.

R. L. asks: Could I receive KYW with a crystal detector and phones?

Answer—Yes, you could receive this station with a crystal detector and phones; however, you should employ a

Pickups

ROLAND ROGERS has ordered a radiophone for his enterprising store in Wapakoneta, O. Butcher & Steinmetz have put in a receiving outfit in their store at Waynesfield, O.

DR. REMSBERG, of Princeton, Ill., entertained friends with a radiophone report of the Greb-Gibbons fight. Many Princeton residents have receiving sets.

THE BELL TELEPHONE Company is planning a radiophone system with a station in each large city.

MUSIC PUBLISHERS are demanding a tax from all sending stations that broadcast their copyrighted music. What would the song-writers say if some of their songs were denied the ether waves? Impure air some day may have a double meaning.

AMATEURS, even the very green readers who are interested may write Radio Age for further information.

CLEVER INVENTORS are trying to find a way to send and receive messages that cannot be understood by others. This effort applies to telephony, not to wireless telegraphy. The plan is to distort the speech so that it will be unintelligible except at the receiving end, which has a set adjusted to straighten out the distortions.

MINING OFFICIALS are considering the radiophone as a means of averting loss of life in mine accidents. They would equip the miner's cap with a miniature transmitter which could send alarm to a powerful receiving station at the mouth of the mine. The receiver would not only catch the signal but locate the point of danger.

hear William Jennings Bryan, who was talking in Pittsburgh.

JOHN EDWARD SNYDER is installing a radio receiver in his ice-cream parlor in Peoria, Ill.

CENTRAL HIGH SCHOOL in Ray

Herbert Parish, a sixteen year old youth of Milwaukee, fitted up a Radiophone set in an hour that can receive messages the same as a regular outfit except at extremely far distances. Herbert hopes some day to join the Signal Corps and believes that he could make good use of his speed in the army. —International Photo.

ones will find the little book "Radio Hook-ups" of great value and interest in their making of receiving sets and in operating them. Another good book for amateurs is "Design Data for

THE CANADIAN GOVERNMENT is considering the permitting of amateurs to use continuous wave transmission up to 250 meters wave length.

JOE ATHERTON, at Macomb, Ill.,

County, Illinois, is ten miles from a railroad or postoffice but has installed a radio set and is now right in the middle of the throbbing world. The students will receive and disseminate

How to Make a Radio Set for $6

Continued from page 8

in sandy soil it may be increased to 10 ft. If some other metallic conductor, such as the casing of a drilled well, is not far away from the window, it will be a satisfactory "ground."

Tuner, Detector and Phone

The detector and phone will have to be purchased. The tuner and certain accessories can be made at home.

Tuner (R, Fig. 3)—This is a piece of cardboard or other non-metallic tubing with turns of copper wire wound around it. The cardboard tubing may be an oatmeal box. Its construction is described in detail below.

Crystal Detector (S, Fig. 3)—The construction of a crystal detector may be of very simple design and quite satisfactory. The crystal, as it is ordinarily purchased, may be unmounted or mounted in a little block of metal. For mechanical reasons the mounted type may be more satisfactory, but that is of no great consequence. It is very important, however, that a very good tested crystal be used. It is probable also that a galena crystal will be more satisfactory to the beginner.

The crystal detector may be made up of a tested crystal, three wood screws, short piece of copper wire, a nail, set-screw type of binding post, and a wood knob or cork. The tested crystal is held in position on the wood base by three brass wood-screws as shown at 1, Fig. 3. A bare copper wire may be wrapped tightly around the three brass screws for contact. The assembling of the rest of the crystal detector is quite clearly shown in Fig. 3.

Phone (T, Fig. 3)—It is desirable to use a pair of telephone receivers connected by a head band, usually called a double telephone headset. The telephone receivers may be any of the standard commercial makes having a resistance of between 2000 and 3000 ohms. The double telephone receivers will cost more than all the other parts of the station combined, but it is desirable to get them, especially if one plans to improve his receiving set later. If one does not care to invest in a set of double telephone receivers, a single telephone receiver with a head band may be used; it gives results somewhat less satisfactory.

Accessories—Under the heading of accessory equipment may be listed binding posts, switch arms, switch contacts, test buzzer, dry battery, and boards on which to mount the complete apparatus. The binding posts, switch arms and switch contacts may all be purchased from dealers who handle such goods or they may be quite readily improvised at home. There is nothing peculiar about the pieces of wood on

Cost of Parts

The following list shows the approximate cost of the parts used in the construction of this radio receiving station. The total cost will depend largely on the kind of apparatus purchased and on the number of parts constructed at home.

Antenna—		
Wire—Copper, bare or insulated, No. 14, 100 to 150 ft., about	$ .75	
Rope—⅜ or ½ inch. 2c per foot.		
2 insulators, porcelain	.20	
1 pulley	.15	
Lightning switch—30 ampere battery switch	.30	
1 porcelain tube	.10	
Ground connections—		
Wire (same kind as antenna wire.)		
1 clamp	.15	
1 iron pipe or rod	.25	
Receiving set—		
½ pound No. 24 copper wire double cotton covered	.75	
1 cardboard box.		
2 switch knobs and blades complete	1.00	
18 switch contacts and nuts	.75	
3 binding posts—set screw type	.45	
2 binding posts—any type	.30	
1 crystal—tested	.25	
3 wood screws, brass, ¾ in. long	.03	
Wood for panels (from packing box.)		
2 pounds paraffin	.30	
Lamp cord, 2 to 3c per ft.		
Test buzzer	.50	
Dry battery	.30	
Telephone receivers	4.00 to $8.00*	
Total	$11.00	$15.00

If nothing but the antenna wire, lightning switch, porcelain tube, crystal, telephone receiver, bolts and buzzer are purchased this total can be reduced to about $6.00.

*Still more efficient and expensive telephone receivers are available at prices ranging to about $20.00.

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may be obtained from a dry packing-box and covered with paraffin to keep out moisture.

Details of Construction

The following is a detailed description of the method of winding the coil, construction of the wood panels, and mounting and wiring the apparatus:

Tuner—See R, Fig. 3. Having supplied oneself with a piece of cardboard tubing 4 in. in diameter and about ½ pound of No. 24 (or No. 26) double cotton covered copper wire, one is ready to start the winding of the tuner. Punch two holes in the tube about ½ in. from one end as shown at 2 on Fig. 3. Weave the wire through these holes in such a way that the end of the wire will be quite firmly anchored, leaving about 12 inches of the wire free for connections. Start with the remainder of the wire to wrap the several turns in a single layer about the tube, tightly and closely together. After 10 complete turns have been wound on the tube hold those turns snugly while a tap is being taken off. This tap is made by making a 6 in. loop of the wire and twisting it together at such a place that it will be slightly staggered from the first tap. This method of taking off taps is shown quite clearly at U, Fig. 3. Proceed in this manner until 7 twisted taps have been taken off turns have been wound on the tube then take off a 6 in. twisted tap for every succeeding single turn until 10 additional turns have been wound on the tube. After winding the last turn of wire anchor the end by weaving it through two holes punched in the tube much as was done at the start, leaving about 12 in. of wire free for connecting. It is to be understood that each of the 18 taps is slightly staggered from the one just above, so that the several taps will not be bunched along one line on the cardboard tube. See Fig. 3. It would be advisable, after winding the tuner as just described, to dip the tuner in hot paraffin. This will help to exclude moisture.

Panel and Base

Having completed the tuner to this point, set it aside and construct the upright panel shown in Fig. 4. This panel may be a piece of wood approximately ½ in. thick. The position of the several holes for the binding posts, switch arms and switch contacts may first be laid out and drilled. The "antenna" and "ground" binding posts may be ordinary ⅛ in. brass bolts of sufficient length and supplied with three nuts and two washers. The first nut binds the bolt to the panel, the second nut holds one of the short pieces of stiff wire, while the third nut holds the antenna or ground wire as the case may be. The switch arm with knob shown at V, Fig. 3, may be purchased in the assembled form or it may be constructed from a thin slice cut from a broom handle and a bolt of sufficient length equipped with four nuts and two washers together with a narrow strip of thin brass somewhat as shown. The switch contacts

$50 Prizes for Boys

Radio Age will pay prizes as follows for the best original articles (with drawings) from boys of 18 years and under, on

How to Make Home Radio Receiving Sets:

First Prize -	**$20.00**
Second Prize	**15.00**
Third Prize -	**10.00**
Fourth Prize	**5.00**

Articles must be clearly illustrated and must be not longer than 2000 words, or shorter than 1000.

Another special prize of $10 will be awarded to the boy of 18 or under who writes and illustrates (with rough sketches) the best original article of about 500 words on how to make the best variable and the best fixed condenser at home.

Winners will be announced in Radio Age--July Number.

(W, Fig. 3) may be of the regular type furnished for this purpose or they may be brass bolts equipped with one nut and one washer each or they may even be nails driven through the panel with an individual tap fastened under the head or soldered to the projection of the nail through the panel. The switch contacts should be just close enough that the switch arm will not drop between the contacts, but also far enough apart that the switch arm can be set so as to touch only one contact at a time.

The telephone binding post should preferably be of the set screw type as shown at X, Fig. 3.

Instructions for Wiring

Having constructed the several parts just mentioned and mounted them on the wood base, one is ready to connect the several taps to the switch contacts and attach the other necessary wires. Scrape the cotton insulation from the loop ends of the sixteen twisted taps as well as from the ends of the two single taps coming from the first and last turns. Fasten the bare ends of these wires to the proper switch contacts as shown by the corresponding numbers in Fig. 3. One should be careful not to cut or break any of the looped taps. It would be preferable to fasten the connecting wires to the switch contacts by binding them back of the binding post marked "ground" (Fig. 3) to the back of the left-hand switch-arm bolt (Y), thence to underneath the left-hand binding post marked "phones." A wire is then run from underneath the right-hand binding post marked "phones" to underneath the binding post (4, Fig. 3), which forms a part of the crystal detector. A piece of No. 24 bare copper wire about 2½ in. long, one end of which is twisted tightly around the nail (the nail passing through binding post 4), the other end of which rests gently by its own weight on the crystal (1). The bare copper wire which was wrapped tightly around the three brass wood-screws holding the crystal in place is lead to and fastened at the rear of the right-hand switch arm bolt (v), thence to the upper left-hand binding post marked "antenna." As much as possible of this wiring is shown in Fig. 3.

Directions for Operating

After all the parts of this crystal-detector radio receiving set have been constructed and assembled the first essential operation is to adjust the little piece of wire, which rests lightly on the crystal, to a sensitive point. This may be accomplished in several different ways; the use of a miniature buzzer transmitter is very satisfactory. Assuming that the most sensitive point on the crystal has been found by method described in paragraph below, "the Test Buzzer," the rest of the operation is to get the radio receiving set in resonance or in tune with the station from which

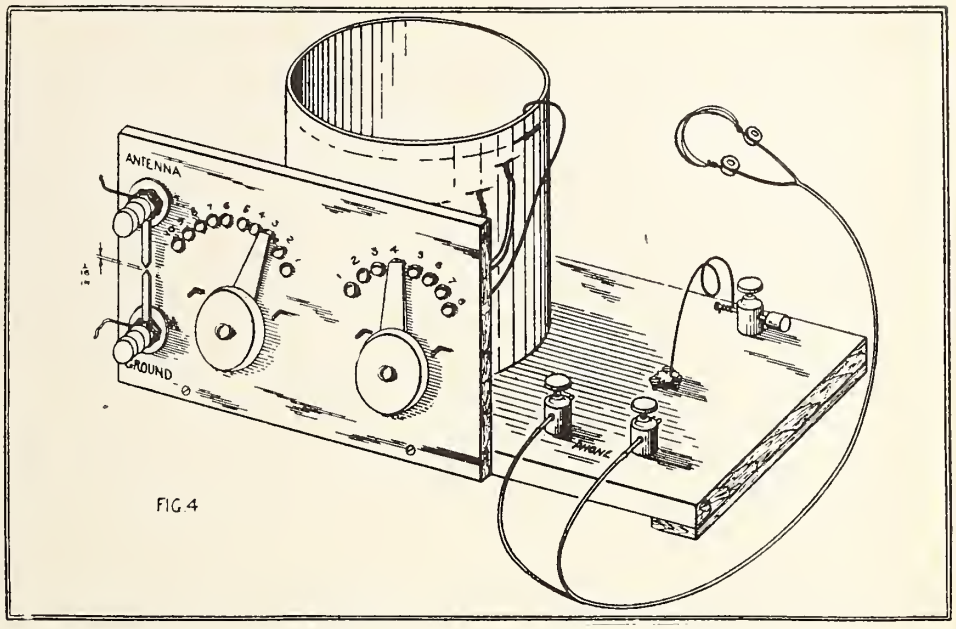


FIG. 4

one wishes to hear messages. The tuning of the receiving set is attained by adjusting the inductance of the tuner. That is, one or both of the switch arms are rotated until the proper number of turns of wire of the tuner are made a part of the metallic circuit between the antenna and ground, so that together with the capacity of the antenna the receiving circuit is in resonance with the particular transmitting station. It will be remembered that there are 10 turns of wire between each of the first 8 switch contacts and only one turn of wire between each 2 of the other contacts. The tuning of the receiving set is best accomplished by setting the right-hand switch arm on contact (1) and rotating the left-hand switch arm over all its contacts. If the desired signals are not heard, move the right-hand switch arm to contact (2) and again rotate the left-hand switch arm throughout its range. Proceed in this manner until the desired signals are heard.

It will be advantageous for the one using this radio receiving equipment to find out the wave frequencies (wave length) used by the several radio transmitting stations in his immediate vicinity.

The Test Buzzer (Z, Fig. 3) — As mentioned previously, it is easy to find the more sensitive spots on the crystal by using a test buzzer. The test buzzer is used as a miniature local transmitting set. When connected to the receiving set as shown at Z, Fig. 3, the current produced by the buzzer will be converted into sound by the telephone receivers and the crystal, the loudness of the sound depending on what part of the crystal is in contact with the fine wire. To find the most sensitive spot connect the test buzzer to the receiving set as directed, close the switch (5, Fig. 3) (and if necessary adjust the buzzer armature so that a clear note is emitted by the buzzer), set the right-hand switch arm on contact point No. 8, fasten the telephone receivers to the binding posts marked "phones," loosen the set screw of the binding post slightly and change the position of the fine wire (6, Fig. 3) to several positions of contact with the crystal unit until the loudest sound is heard in the phones then tighten the binding post set screw (4) slightly.

WILLIAM TERRELL, a Peoria man was suspected of stealing a radio outfit. A wireless telephone message broadcast from the Bradley station described the instrument. An amateur operator in Peoria promptly reported that Terrell had tried to sell him such an instrument. Terrell faces the grand jury now. Pretty slick thief who can hide from those wireless waves!

Great Radio Shows

Continued from page three

Delegations from many of the neighboring states have made reservations. A party of at least 30 dealers went from Detroit alone. The smaller cities and rural districts within easy receiving distance of the local broadcasting stations are among the most enthusiastic centers. All roads in the radio field lead toward Pittsburgh during the week.

The American Radio Exhibitors' association conducting the show has compiled information concerning the industry which is available to all the dealers, distributors and manufacturers. Special shipments of complete sets and supplies have been made by several of the manufacturers. This material is available for the public at the exhibition, says the Pittsburgh Press. Competent engineers are on hand at the information booth to answer any questions concerning radio which the visitors may ask.

Learn the Code

Before one starts receiving, he should master the language of the air. This is not the sound that is broadcast—but the dot and dash signals of the International Morse Code.

Don't throw up your hands in despair. It is not hard to learn. Once mastered, you will be able to get the full pleasure of "listening in"—you will get the secrets that are flying about all the time.

A little practice each day and you will be fascinated by decoding these mysterious dots and dashes.

Cut out this chart. Mount it on cardboard for ready reference.

The code may be learned by visualization. But it is much easier to learn it by sound. A tapping of a peneil will do. The best way, however, is to rig up a little buzzer and hear the real thing.

Get a high pitched buzzer, an ordinary telegraph key and a common dry battery. They can be purchased in any supply store at a small cost.

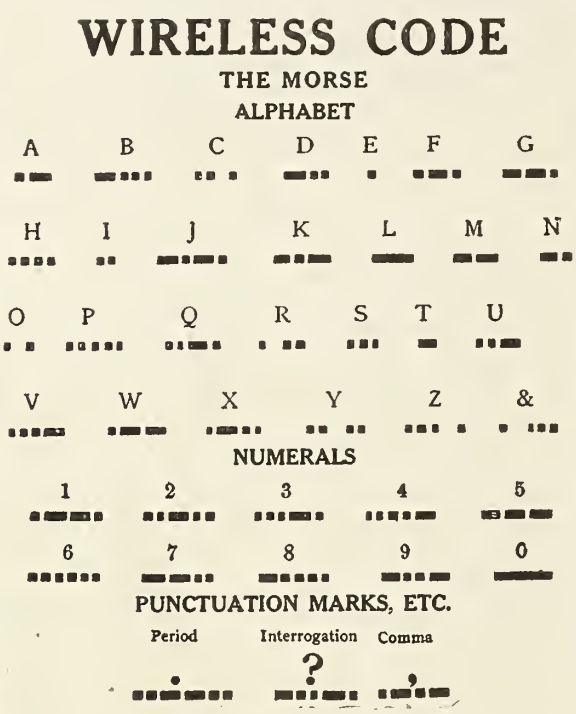
Mount the key on a table or desk, allowing plenty of room for the forearm. Connect the battery and buzzer according to the diagram.

When your hand is set have your wrist clear and your thumb resting lightly against the knob of the key. The index and third fingers should be on top and the other two fingers should be curved baek into the hand.

The wrist should do the sending—the thumb and fingers acting merely as a guide for the wrist.

The spring in the key should be screwed down just enough to force the key up after each wrist action.

Dubuque (Ia.) Times.



B. F. ELBERT, manager of a Des Moines, Ia., theater, will have music by wireless as a substitute for an orchestra.

ALBERT E. PROFFITT, of Providence, R. I., has discovered a means of listening in on telephone conversations with his radio outfit. He declines to tell how he does it. The secret lies in the wiring of his amplifier.

Boy Scouts

Boy Scouts are sure to become an important faetor in radio. It was a boy scout at the recent radio conferenee in Washington who arose and made an eloquent appeal for a closer union between the various government departments and broadcasting stations so that the boys in all eommunities might learn more of what is going on in the United States. He even suggested that the boys be permitted to listen in on the debates in Congress.

Unless that scout has heard some of our long-winded statesmen windjamming in the Senate or the House, he has little idea of what he is letting himself and other boys in for. But eaeh new revelation might help him to cast an intelligent vote later on.

Boy Scouts are organizing their radio members so that they will be of assistanee to the government in emergeney. A better, more promiseful spirit could not be manifested by the little fellows who are to be the future masters of the magic science.

INABILITY TO GET PHONES for radiophone receivers is delaying the installation of many amateur plants in Peoria, Ill.

Soldering

Any person installing a radio set should know how to solder and do it right. A book might be written on the subject but only a few points will be given here.

1. Be sure the wires of the parts to be soldered are absolutely clean. File, scrape or sandpaper them until they are bright.

2. Use a good soldering flux. Get a can of good soldering paste and learn how to apply it. Use as little as possible and when the joint is completed carefully wipe off all surplus paste which acts as a conductor and may short circuit the wires. Never, under any circumstances, use muriatic or hydrochloric acid eut with zinc. Eleetrolysis takes place and produces a eorroded joint.

3. Always remember that the parts must be as hot as the melted solder before a good joint can be produced. Never let the soldering iron get red hot. A green flame around the iron indicates that the copper is burning and should be removed from the fire.

4. To "tin" the "iron" heat on a gas stove until the green flames just begin to show, take off the "iron" and file until the copper shows brightly. Dip the tip in a little paste and immediately rub on a bar of solder. This will leave the tip of the "iron" covered with solder and bits of solder may be picked up and deposited wherever desired. If the "iron" is not "tinned" solder will not stick and it is next to impossible to solder joints.

—Orval Whishman in Rockford Star.

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Radio in School

Thousands of boys are studying praetieal radio in the public sehools. The number of boys devoting their major time to this work is particularly large in the Chicago Technical High Schools. In many sehools, in addition to the regular eourses in eleetrieal study the boys have radio clubs. Lane, Tilden and Crane, the three larger "tech" schools have clubs and interest in them and in radio is inereasing daily.

The president of the Peoria School Board has said that radio will be placed on the list of studies "as soon as it becomes practical" and any number of boys in Peoria reply that it is practical already. They want radio elasses now. The radio club of Waukegan High Sehool has seventeen members and some of them have sets with whieh they ean hear music broadcast from Chicago.

Athletic events in whieh rival high sehools are engaged are so closely followed by stay-at-home students that the radio has been brought into action to carry play by play the progress of the struggles. This plan reeently was adopted with success by Roekford, Ill., high school during a contest with Urbana, at Urbana.

Radio interest is by no means limited to the teehnical and other high sehools. 'Varsity men are just the same sort of fans as their younger brothers. As a matter of fact all men are boys when it comes to playing with ether waves and listening to the invisible choir. Michigan University announees a Radio night for April 29. Fielding H. Yost, athletic director at Ann Arbor, plans to make it a wireless reunion of alumni. Faculty members, glee elub singers and athletie stars will partieipate in the program and it will be broadcast.

News will be broadeast once a week from the University of Wisconsin station at Madison. The wave length is 360 meters. The news digest will be sent eaeh Friday night at the elose of the weekly radiophone concert.

Wisconsin students carry on a news exchange between the newspapers of other eolleges in Wiseonsin and in other states from 10 to 12, midnight, every Monday.

Bradley Station, Peoria, Ill., is improving the apparatus of the Bradley Institute. The present sending wave length is 200 meters but it will be increased to a possible 450 meters with the new equipment.

Union College, Sehenectady, N. Y., has resumed its broadeast service. The station will broadeast under its newly assigned eall letters WRL but the elub retains its old lieense 2XQ for purposes other than broadcasting.

It is reported in the press that New York University will permit students to stay at home and get their lectures via the radiophone. Maybe so, maybe so, but let us not get too close to the

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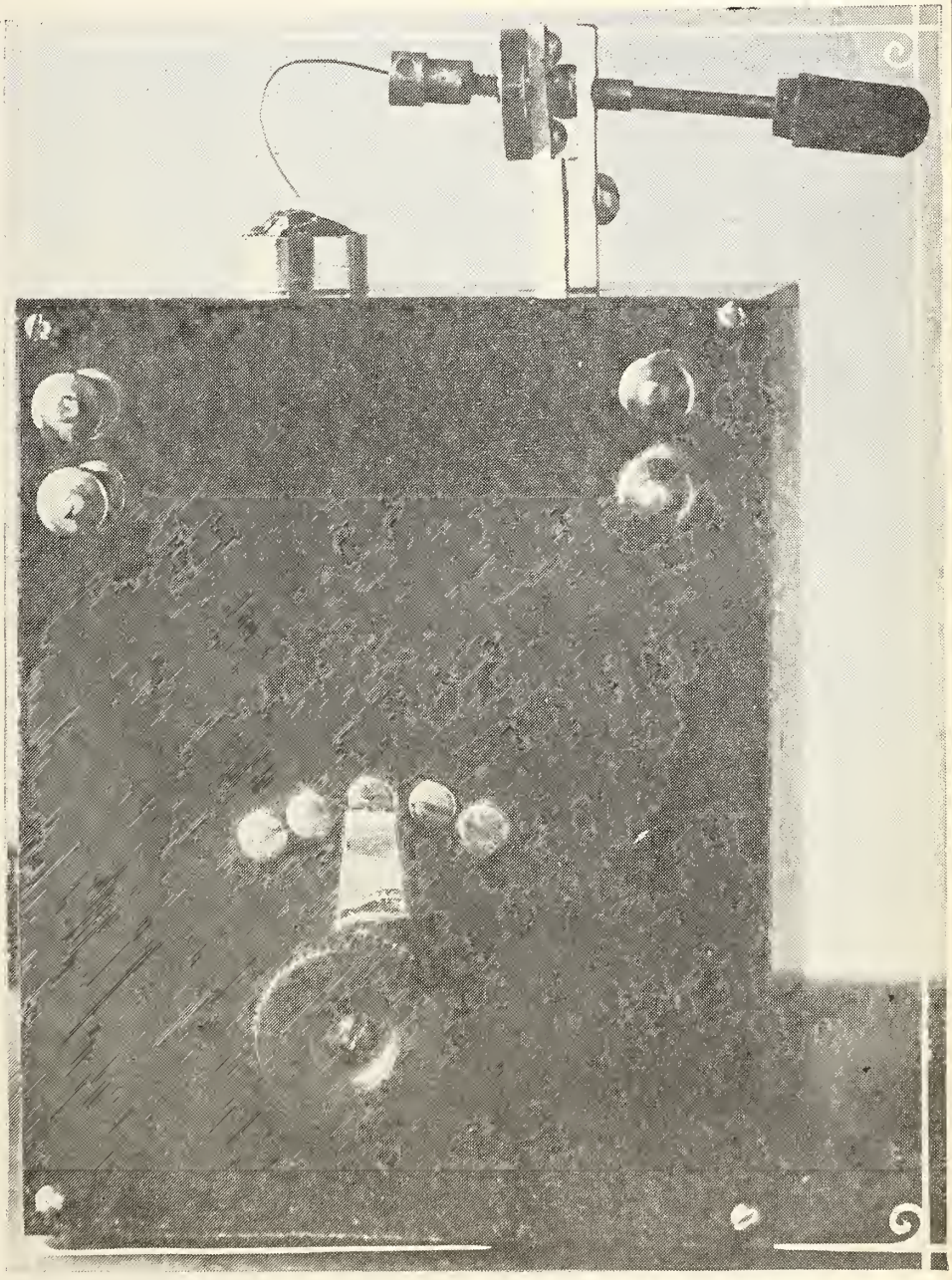

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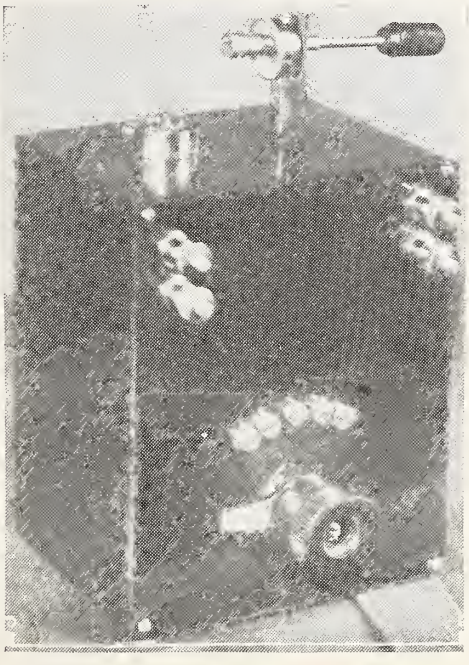

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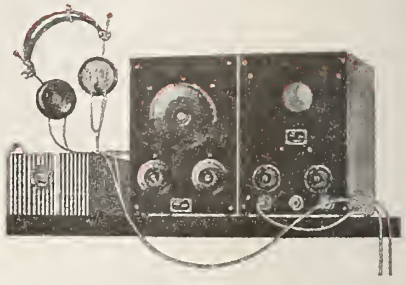

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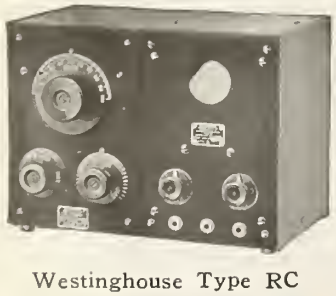

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The Magazine of the Hour

JUNE, 1922 25c A COPY

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Advertisers, who have let us broadcast their business messages to many thousands who were waiting for those messages.

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RADIO AGE

The Magazine of the Hour

Volume 1 *Number 2*

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What is in Store for RADIO AGE Readers

The acquisition of Frank D. Pearne as Technical Editor on the staff of RADIO AGE insures authoritative interesting material for our magazine. Mr. Pearne is chief instructor in electricity at Lane Technical High School and knows how to discuss radio technique with beginners.

Mr. Pearne will not only write and illustrate a helpful article each month but he will conduct the questions and answers, always a popular feature in publications dealing with wireless.

There are to be three big radio shows in Chicago and several others in the "Chicago Territory" before August and some of these will be attended by important conferences at which radio history will be made.

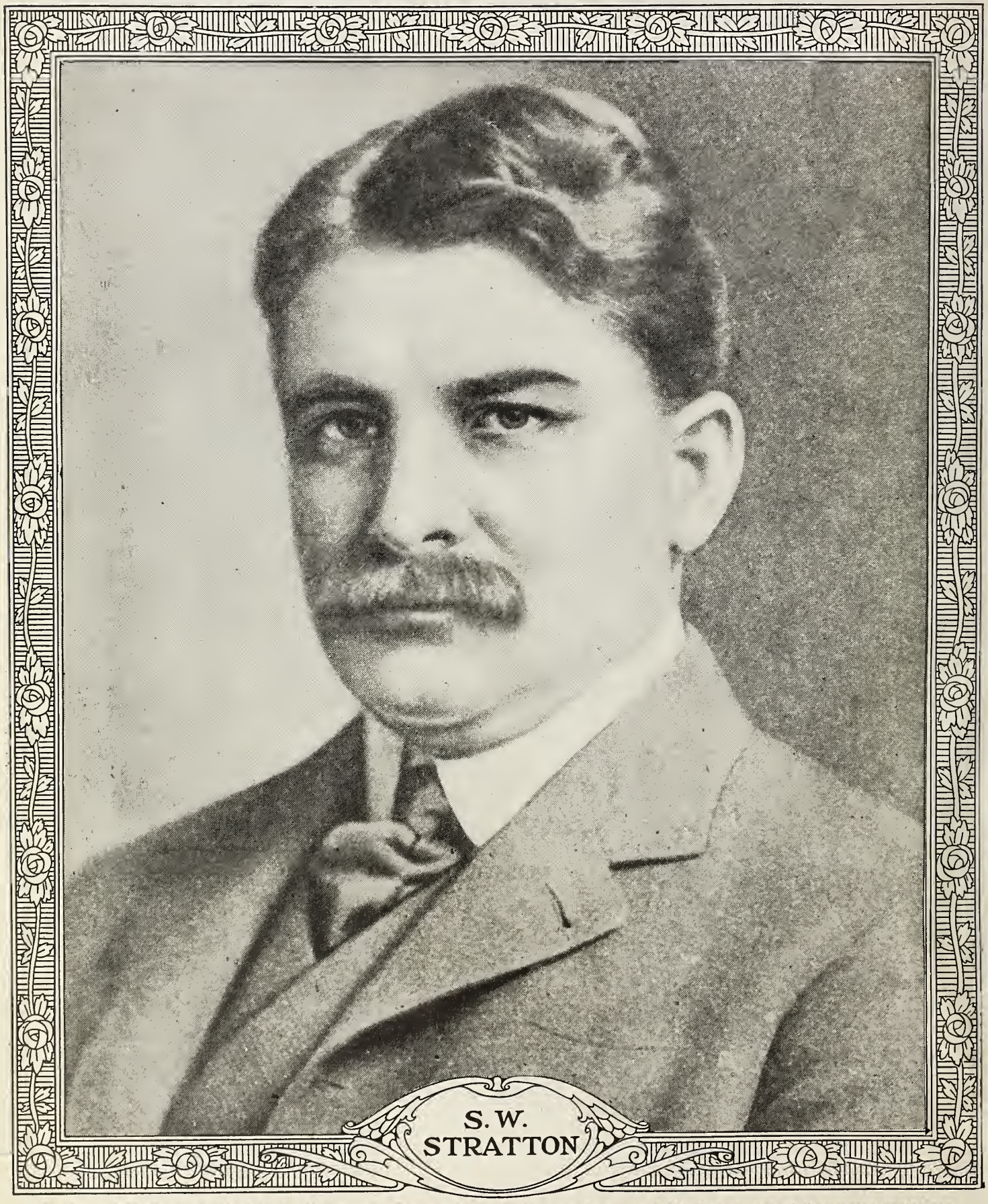
It is the privilege of the editor to be associated in an advisory capacity with three of these approaching expositions and our readers may be sure of getting complete information of them.

This number contains the complete report in the recent Department of Commerce conference on radio regulation. The report is voluminous but we are so sure of the interest in this subject, among big manufacturers as well as among dealers, expert operators and amateurs, that we have arranged for other comprehensive articles of a similar nature.

In the July number we are to have a most interesting story by a man who made his own receiving set for $3.85 and went on from there until he—but read his own story.

Nothing would please the editor more than to receive letters from our readers. Criticism in invited. News forwarded to us will be used where practicable and unused manuscripts will be returned if stamped and addressed envelopes are supplied.

Who's Who in Radio



Dr. Samuel W. Stratton, Chief of the Government Bureau of Standards, was chairman of the Department of Commerce conference called by Secretary Hoover to recommend laws governing radio communication. Dr. Stratton formerly was professor of physics at the University of Chicago and has been director of the Bureau of Standards for more than twenty years. He is an Illinois man.

RADIO AGE
"The Magazine of the Hour"
M. B. SMITH, PUBLISHER
PUBLISHED MONTHLY GARRICK BLD'G CHGO.
FREDERICK SMITH, EDITOR

How the Government Will Control Radio

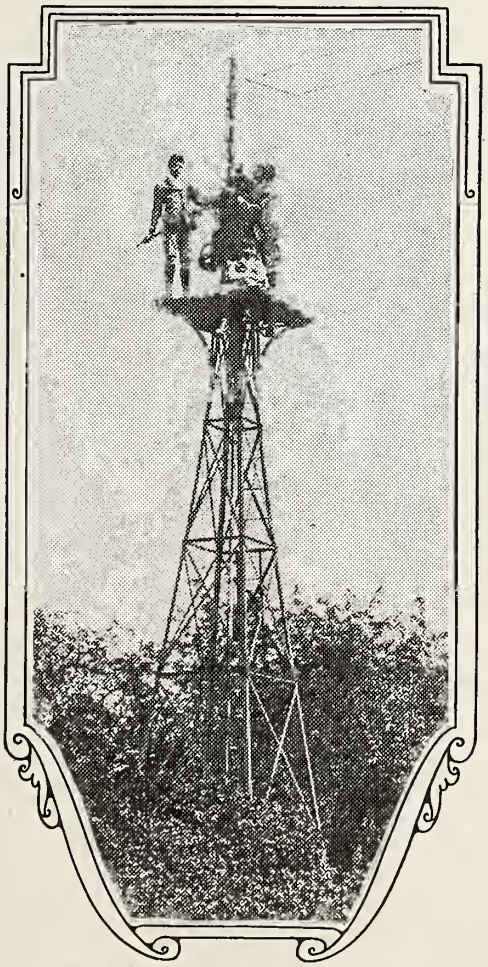
By FREDERICK SMITH

AT LAST the radio wise men of the United States have agreed upon a definite comprehensive plan whereby users of radio telephones and the radio telegraph may know how, where and when they may use the magic electro magnetic waves as a means of communication.

Just before going to press we are in receipt of the complete official text of the report made by the Department of Commerce conference on radio telephony, which adjourned its second session on April 19. The report is published in full in this number because it is the most important document of the day, interesting alike the small boy with his home-made receiving outfit and the million dollar corporation with its powerful transmitting station.

A mere glance at the report will convince the public that the conference had a giant task to perform. Since the installation of broadcasting stations started several years ago the number of stations has increased to such an extent that chaotic confusion has resulted. Government broadcasting, public broadcasting, private broadcasting and toll broadcasting have overlapped and clashed until it seemed that it was impossible to straighten out the tangle.

Marine radio service was sadly hindered by operators outside the government service along the coasts. Public and private broadcasts destroyed the value on one another until the radio telephone listener was frantic over repeated disappointment. Probably most important of all was the status of the amateur who was trying to advance his knowledge of the science by practicing it and thus make himself a valuable unit in the vast system of radio telephony which is soon to be one of our most important national assets. His broadcasting very often jammed up the music, speeches, baseball scores, weather predictions and market information that thousands of persons were trying to pick up with their receivers. But the amateur had to be taken care of, nevertheless. Under the new regulations he will have his place in the ether.



Radio has caught the boys in England, too. The boys at an elementary school at Haslemere, England, have transformed this old windmill into an aerial tower. Kadel & Herbert Photo

The recommendations made by the Washington conference will be made the basis for congressional legislation. The bill being drafted by Representative Wallace H. White, Jr., of Maine, will put the recommendations into the form of a law and this will be the first adequate legislation on the subject in the last decade.

Radio laws will be so amended as to give the Secretary of Commerce (Mr. Hoover) authority to control the establishment of all radio transmitting stations except amateur, experimental and government stations. He also will be authorized to control the OPERATION of non-governmental radio transmitting stations. How this federal control is to be established is explained in part in the following conference recommendation, one of the most interesting in the report:

> It is recommended that for the purposes of self-policing among the amateurs, Amateur Deputy Radio Inspectors be created, elected from their number of the amateurs of each locality; that upon receipt of notice of such election the Radio Inspector in charge of the district in which such amateurs are located shall appoint the person chosen a Deputy Radio Inspector, serving without compensation or for the sum of one dollar per year if compensation is legally required; that the duty of such Amateur Deputy Inspector shall be to endeavor to the best of his ability to accomplish, under the direction of the District Radio Inspector, observance of the Radio Communication Laws and the Regulations of the United States and the observance of such local co-operative measures as are agreed to in each community for the minimization of interference between the various groups of the public interested in radio; that such amateur Deputy

Radio Inspectors be clothed with whatever authority may be necessary in the opinion of the District Radio Inspector.

That means the young traffic cop of the air will be listening in for those reckless and inconsiderate despoilers of the air and will report them to headquarters. The transmitting station will be extremely careful not to commit any evils which may lead to the revocation of its precious sending license.

Direct advertising is explicitly prohibited in the recommendations of the conference. Radio is termed a public utility in which the mass of the people is most vitally interested and it is the aim of the proposed legislation to gain the most good for the greatest number.

For this reason the conference resolved "that the types of radio apparatus most effective in reducing interference should be made freely available to the public without restriction."

The conference adjourned its first session on March 2 to give the radio public opportunity to discuss and criticise the plans for regulation. The report as finally adopted and here published in full is therefore the consensus of that tremendous army of radio enthusiasts which is gaining recruits to the number of many thousands each month.

The complete conference report follows:

Final Allocation of Wave Lengths

	Use	Wave Length Meters	Wave Frequency Kilocycles per sec.
(1)	Transoceanic radio telephone experiments, non-exclusive. (See Note 3)	6,000	50.
		5,000	60.
(2)	Fixed service radio telephony, non-exclusive. (See Note 4)	3,300	90.9
		2,850	105.2
(3)	Mobile service radio telephony, non-exclusive	2,650	113.2
		2,500	120.
(4)	Government broadcasting, non-exclusive. (See Note 1)	2,050	146.
		1,850	162.
(5)	Fixed station radio telephony, non-exclusive. (See Note 5)	1,650	181.8
		1,550	193.5
(6)	Aircraft radio telephony and telegraphy, exclusive	1,550	193.5
		1,500	200.
(7)	Government and public broadcasting, non-exclusive	1,500	200.
		1,050	285.7
(8)	Radio beacons, exclusive. (See Note 6)	1,050	285.7
		950	316.
(9)	Aircraft radio telephony and telegraphy, exclusive	950	316.
		850	353.
(10)	Radio compass service, exclusive. (See Note 7)	850	353.
		750	400.
(11)	Government and public broadcasting, 200 miles or more from the seacoast, exclusive	750	400.
		700	428.
(12)	Government and public broadcasting, 400 miles or more from the seacoast, exclusive	700	428.
		650	462.
(13)	Marine radio telephony, non-exclusive. (See Note 8)	750	400.
		650	462.
(14)	Aircraft radio telephony and telegraphy, exclusive. (See Note 8)	525	572.
		500	600.
(15)	Government and public broadcasting, exclusive	495	606.
		485	618.
(16)	Private and toll broadcasting. (See Note 9)	485	618.
		285	1,052.
(17)	Restricted special amateur radio telegraphy, non-exclusive. (See Note 10)	310	968.
(18)	City and state public safety broadcasting, exclusive. (See Note 11)	285	1,052.
		275	1,091.
(19)	Technical and training schools (shared with amateur). (See Note 12)	275	1,091.
		200	1,500.
(20)	Amateur telegraphy and telephony (exclusive, 150 to 200 meters). (Shared with technical and training schools, 200 to 275 meters). (See Note 13)	275	1,091.
		150	2,000.
(21)	Private and toll broadcasting, exclusive	150	2,000.
		100	3,000.
(22)	Reserved	below 100	above 3,000

DEPARTMENT OF COMMERCE

Washington

This conference was called by Secretary Hoover to consider general questions concerning the regulation of radio communication.

The following were invited to serve as members of the Conference, the representatives of the Government departments being selected by their several departments:

Dr. S. W. Stratton, Chairman (Director of Bureau of Standards).

Mr. Edwin H. Armstrong, Columbia University, New York, N. Y.

Capt. Samuel W. Bryant, U. S. N., Navy Department.

Mr. D. B. Carson, Commissioner of Navigation, Department of Commerce.

Mr. J. C. Edgerton, Supt., Radio Service, Post Office Department.

Dr. Alfred N. Goldsmith, Secretary, Institute of Radio Engineers, New York, N. Y.

Mr. R. B. Howell, Metropolitan Utilities District, Omaha, Nebr.

Prof. C. M. Jansky, Jr., University of Minnesota.

Senator Frank B. Kellogg of Minnesota.

Mr. Hiram Percy Maxim, President, American Radio Relay League, Hartford, Conn.

Major General George O. Squier, War Department.

Representative Wallace H. White, Jr., of Maine.

Mr. W. A. Wheeler, Bureau of Markets and Crop Estimates, Department of Agriculture.

The conference was in session from February 27 to March 2, at the end of which time a Tentative Report was prepared. This report was sent to all persons who requested it, and to representatives of various interests, which in the judgment of the Department of Commerce were interested. A large number of suggestions and comments were received. The Conference had subsequent sessions on April 17, 18 and 19. All comments were considered, the general effect of the comments being to approve the substance of the preliminary report with a very few exceptions. The report as finally amended and adopted is given herewith.

In addition to preparing a report on technical matters, the Conference made recommendations as to essential points required in legislation to give the Secretary power to make and enforce regulations.

General Resolutions

Resolved that the Conference on Radio Telephony recommend that the radio laws be amended so as to give the Secretary of Commerce adequate legal authority for the effective control of:

(1) the **establishment** of all radio transmitting stations except amateur, experimental and Government stations.

(2) the **operation** of non-Governmental radio transmitting stations.*

Resolved that it is the sense of the Conference that radio communication is a public utility and as such should be regulated and controlled by the Federal Government in the public interest.

Resolved that the types of radio apparatus most effective in reducing interference should be made freely available to the public without restriction.

I. Allocation of Wave Bands

A. It is recommended that waves for radio telephony be assigned in bands, according to the class of service, as given in the accompanying table.

Throughout this report, both wave lengths and wave frequency are given. Wave length in meters is 300,000,000 divided by wave frequency in kilocycles per second.

Wave bands marked **exclusive** can be used for no other type of service; those marked **non-exclusive** are available for other types of radio communication, subject to regulation.

*It was the desire of the Conference that the present authority of the Secretary of Commerce over the operation of radio transmitting stations be extended and that the Secretary of Commerce be granted authority to control the erection or establishment of certain classes of radio stations.

(*Continued on page* 25)

Shows Introducing Radio to Throngs

Middle West Fans Await Milwaukee, Toledo and Chicago Expositions

RADIO showmen appear to have no difficulty in convincing manufacturers and dealers that the radio show is the thing to get the business. This is not surprising when we look over the thousands of enthusiasts who have been crowding these exhibitions. Each demonstration of a radio outfit has an unmistakable kick of thrilling interest in it. The shows have become a means of giving many thousands of persons their first dip into the ether waves. Also the exhibits have intensely interested those fans who are beyond the first stage of radio learning and want to see the newest and most improved equipment.

Shows are supplying additional proof of the momentum the industry has accumulated. One year ago a radio show on a big scale failed to deliver a profit. This year the fans have been mobbing the entrances.

New York had one big show in the Pennsylvania Hotel and will have several others before next winter, the first of which was announced for the Seventy-First Regiment Armory, May 22 to 29, inclusive. Boston, Newark and Brooklyn have dropped into line with big exhibitions. Toledo's first show is being held during the week of May 29.

Milwaukee Leads the Way

The Wisconsin Section of the American Radio Relay League will meet in its first state convention in Milwaukee on dates concurrent with the Wisconsin Radio and Electrical Show, to be held in the Auditorium, Milwaukee, June 21 to 25, inc. The convention will meet in the same building in which the show is held. Popular and technical talks by nationally known speakers are being arranged for the convention program.

This bear cub, only a month old, may be listening to somebody's broadcasting station, but she more likely is just hearing the old call of the wild. Science seems to bore her. Her name is Marion and she lives in Seattle, Wash. International News Reel Photo

Spearman Lewis, managing director of the Allied Bazaar, the most successful show ever staged in the Coliseum, Chicago (net cash profits, $535,000), is managing director of the Wisconsin Radio Show. His headquarters are at the Plankington Hotel, Milwaukee. Selling exhibitors' space has been largely a question of installing enough telephones at show headquarters to get the incoming calls and inquiries.

Milwaukee claims the finest exposition building in America—the Auditorium—and every indication points to tremendous attendance and unusually interesting exhibits. The famous "KYW" of Chicago will be represented as a compliment to Mr. Lewis, who arranged the first Mary Garden-Edith Mason grand opera demonstration over "KYW" last November.

The First Chicago Show

For the purpose of discovering the young Edisons of wireless and to

help make Chicago the radio center of the world the committee in charge of the prizes to be awarded in the various contests at the National Radio Exposition to be held in Chicago June 26th to July 1st, in the Leiter building, have announced the prizes that will be awarded. The committee includes J. C. Hail, in charge of radio station WBU, City Hall, chairman; Prof. R. R. Hughes, Evanston High School, and F. D. Pearne, of the Department of Electricity, Lane Technical High School.

The prize awards are classed as follows:

Grade Schools—For making the best Crystal Detector set—170 to 600 meters: 1st prize, $25; 2nd, $15; 3rd, $10.

High Schools and Manual Training Schools—For making the best regenerative Detector, two-stage amplifier set—175 to 600 meters: 1st prize, $50; 2nd, $30; 3rd, $20; boys under high school age are eligible, but they must be in school.

Contest Open to Anyone under 21 years old—For making the smallest set for receiving code and of practical use: 1st prize, $50; 2nd, $30; 3rd, $20.

Contest Open to Anyone—For making Loud Speaker of own design throughout; one grand prize of $100.

Contest Open to Anyone—For making the greatest radio novelty: one grand prize of $100.

All the devices entered in the various contests must be the headquarters of the National Radio Exposition, 417 S. Dearborn Street, Room 401, by 8 o'clock Friday evening, June 23rd. The contestant must appear in person before that time, when he will be given a ticket of admission to the show and will be told the day on which the awards will be made in his particular contest.

Not a Dull Hour Here

An advisory committee of experts is arranging the general details of the exposition. This committee consists of J. Elliott Jenkins, chairman; J. C. Hail, W. S. Hedges, radio editor, Chicago Daily News; Prof. R. E. Hughes; G. H. Jaspert; F. D. Pearne. E. C. Rayner, Editor Radio Digest; L. R. Schmidt; Frederick Smith, editor, Radio Age; Alfred Thomas, Jr., district manager of the Radio Corporation of America; Norman E. Wunderlich, Radio Topics. At the first meeting of this committee it was decided to provide an educational program that will give the visitor to the exposition a liberal education in radio. This program, held in a conference room, will be in the nature of open forum discussions, with a prominent speaker at each meeting, one at 10 o'clock in the morning and the other at 2 o'clock in the afternoon daily. Days will be set aside for dealers and manufacturers, doctors and hospital people, ministers, golfers.

In addition to the exhibits of manufacturers and dealers there will be many features and demonstrations. A broadcasting outfit will be installed by the Westinghouse station, in charge of G. H. Jaspert, where everything that is in the air will be received and can be heard by the visitors to the exposition. The technical schools of Chicago will have exhibits of their handicraft. The students not only will display what radio parts and outfits they have made in their schools, but they will actually manufacture them at the exposition. Some of the instructors and students at these schools not only have invented improvements in radio devices, for which they have obtained patents, but they have made outfits that rival the commercial outfits.

The advisory committee decided to turn over space to the Army, Navy, Department of Commerce, Weather Bureau, Boy Scouts, Girl Scouts, Sea Scouts and Campfire Girls for radio displays.

Pageant of Progress Show

One of the great radio shows of the year in the United States will be a feature—almost surely the foremost feature of the second annual International Pageant of Progress Exposition which opens on July 29th and closes August 14th, 1922. It is predicted that a million and a half persons will see this exhibition of wireless products.

A preliminary meeting of the radio directors of the Pageant of Progress was held in the Gray Room of the Hotel Sherman, on the evening of May 2. Mayor William Hale Thompson was present and delivered a speech which positively identified His Honor as one of us. The Mayor spoke eloquently of the future of radio.

Dr. John Dill Robertson, president of the exposition, introduced George B. Foster, of the Commonwealth Edison Company, as the chairman of the meeting. Mr. Foster called on several speakers, including former Lieutenant Governor Barratt O'Hara, District Inspector L. R. Schmitt, Secretary Tansey of the Radio Club of Illinois, Spearman Lewis, Milo E. Westbrooke, U. J. Herrmann and George E. Carlson, Chicago Commissioner of Electricity.

The speakers all expressed confidence in the belief that Chicago had the opportunity to become the center of radio in this country. Mr. Foster, in his interesting and instructive address, said he was informed there would be five Chicago shows this year.

The interest displayed at this dinner indicates that those who fail to attend the Pageant of Progress radio show or neglect the opportunity to exhibit radio wares there will overlook a choice opportunity.

Offices of the Pageant of Progress are at 7 West Madison street.

The October Show

The Chicago Radio Show to be held at the Coliseum, October 14th to 22nd, is rapidly assuming not only definite proportions, but promises to be of unusual interest to the Radio trade in general. The Coliseum being recognized internationally as the center of trade expositions, gives any exposition held there, prominence throughout the country.

U. J. Herrmann, the managing director, has opened permanent offices in Suite 549 McCormick Bldg., and has appointed James F. Kerr, Manager of the Exposition. Many novel features in the arrangement of floor space are being worked out, to make the Exposition of equal interest to manufacturers and the public in general. Applications are coming in from all corners and the first foreign application was received from Paris, France, this week.

Manufacturers have a most optimistic view of market conditions bettering themselves during the summer months, as much of the patent litigation will be exhausted, thus leaving the manufacturing field in a more settled and stable condition.

Reassuring the Dailies

J. C. McQuiston, former president of the Association of National Advertisers and now manager of Westinghouse publicity, addressed the advertising association in Chicago recently.

"Radio cannot replace the newspaper," he said. "Radio will be a supplemental agency and will develop more reading of the newspapers for news, as radio broadcasting of bulletins will create the desire for further details and for confirmation. After all, the printed word is necessary to give the final touch of authority."

How to Make a Receiving Transformer

By FRANK D. PEARNE

Chief Instructor in Electricity at Lane Technical High School, Chicago

THE American boy is always anxious to make things with his own hands, and it can truthfully be said that more real pleasure can be obtained from something which he makes himself, than from something which he buys.

For the benefit of those so inclined I am going to describe an easily made receiving transformer which when completed and wired as shown in the diagram Figure 4 of this issue, will give excellent results. Figure 1 shows the complete coil and if the maker will follow the instructions closely, he will have a transformer that will look as well as any which he might purchase.

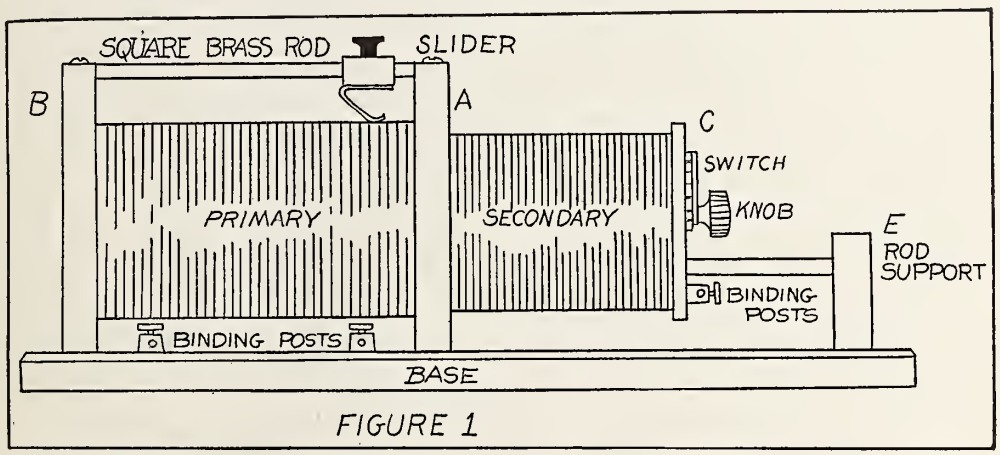


FIGURE 1

The first thing to do is to get some hard wood to use in the construction of the base and the ends for the coils. Mahogany is the best, as it can be given a fine finish, but this is usually hard for the average boy to obtain. If this cannot be secured, oak will do, and if this is outside of his reach, he may go to the grocery store and get a hard wood packing case and use the good parts of it for this work.

The base is made of a good clear piece of wood 16 by 10 inches and ¾ of an inch thick. After this has been made, go over it well with sandpaper, give it a good coat of varnish, and put it away to dry. Figure 2 shows the details of the ends for the primary coil. The primary end "A" is 5¼ inches high, 4¾ inches wide, and ⅝ inches thick. A hole 4¼ inches in diameter is cut from this piece, taking as the center, a point 2⅜ inches from the bottom and 2⅜ inches from the side. This should be carefully done with a jig saw. A slot is then cut from the front to the back. This should be ¼ inch deep and ¼ inch wide. Sandpaper this, varnish, and

Care in Measurement

The primary end "B" is made the same size as "A" but do not cut hole through this end. Instead of cutting this one out, cut out a circular piece of wood 4 inches in diameter and ¼ inch thick and glue it on to the end "B" as shown in the drawing. Care must be taken to see that the center of this round piece comes at exactly 2⅜ inches from the bottom, and the same distance from the sides. Drill two ¼ inch holes ½ inch deep at the points indicated in the side view of primary end "B" Figure 2. Cut a ¼ inch slot across the top similar to the one made in the end "A" as shown, sandpaper, varnish and set it aside to dry.

The next thing in order is to make the secondary end "C". If possible this should be turned out in one piece on a lathe, as it makes a very neat job when completed, but as the average boy does not have a lathe at his disposal he can make it of two pieces cut out with the jig saw. The first piece is 4⅜ inches in diameter and ¼ of an inch in thickness. Another round piece is cut 3⅛ inches in diameter and ¼ of an inch thick, and glued fast to the first piece as shown in the side view of the secondary end "C" Figure 2. If this is made with the saw, the large piece will have to be very carefully sand-papered to make it look like a real job. A $\frac{3}{16}$ inch hole is drilled through the center for mounting the switch lever later. Fifteen holes are then drilled around in a circle with a ⅛ inch drill for mounting the switch two binding posts in the location shown in the back view of the secondary end "C" Figure 2. When this is finished it should be varnished and put away to dry.

USUALLY the first radio receiving set with which the amateur comes in contact is one which uses the double slide tuning coil for making the adjustments to receive waves of different lengths. These serve their purpose during the elementary period of the beginner's experience, and then he looks about him for something a little better, which will give sharper tuning and which will also enable him to pick up stations which he could not get before. This he finds in the loose coupler, or receiving transformer, by which the receiving set is inductively coupled to the aerial and ground. With this idea in view, we publish in this issue, the complete instructions for the making of a receiving transformer.

The Rod Support

Now saw out the secondary end "D" Figure 3. This can be made of any kind of wood and should be 3⅛ inches in diameter and ½ inch thick. Drill two ¼ inch holes 1 inch from each of the center lines as shown, to be used for the supporting rods. This should also be varnished to prevent warping. Next cut out an oblong piece of hard wood for the rod support "E" as shown on Figure 3. This is to be 3 inches long and 2 inches wide, and ⅝ of an inch in thickness. Two holes are to be drilled ½ inch deep in one side in the location shown on the drawing. These holes should be ¼ inch in diameter, and great care should be used so that the drill does not go all the way through, as this would spoil the appearance of the coil, when finished. This like the other pieces, should be carefully sandpapered and varnished.

This completes the wood work, and the next thing to take up will be the winding of the coils.

Winding the Coils

Procure a pasteboard tube 6 inches long 4¼ inches in diameter on the

outside and 4 inches in diameter on the inside. If this is hard to get use an oatmeal box and cut it off the proper length. The tube on the model coil from which these specifications are taken was made from an oatmeal box. Cut the ends of this tube nice and square all around, and punch two holes through it with a small awl, ¾ of an inch from the end. Now punch 2 more holes ⅛ inch from the other end, exactly opposite from the first two. These holes are to accommodate the ends of the wires and should be about ½ inch apart. As the wires are to come out on the same side of the tube it is necessary that the holes be on the same side. Use No. 22 enamel insulated wire for this coil.

Put about 12 inches of this wire down through one of the holes, and bring it up again through the hole next to it and begin the winding. This winding will begin ¾ inch from the end of the tube and continue to within ⅛ inch of the other end, which should bring it directly up to the holes punched in that end. Anchor the final end of the winding by threading it through the two holes as you did on the starting end. When this is done, give the coil a coat of shellac varnish and let it dry. Now there will be a ¾ of an inch of the tube on one end which is not covered with wire. This should be set into the hole in the primary end "A" Figure 2 and glued fast. There will then be ⅛ of an inch of the bare tube showing between this end and the winding. Glue the other end of the tube over the projection on the primary end "B" as shown in the side view Figure 1. Before gluing the tube fast, be sure to see that the terminals of the coil are set so that they will come out at the bottom, so that they may easily be threaded through holes in the base.

Now get another tube, 5⅜ inches long, 3⅜ inches outside diameter, and 3⅛ inches inside diameter. Punch one hole in the end of this tube, as you did in the other. This should be ⅛ of an inch from the end. Use No. 24 single cotton insulated wire for this coil. Put about 12 inches of the wire down through

(*Continued on page* 22)

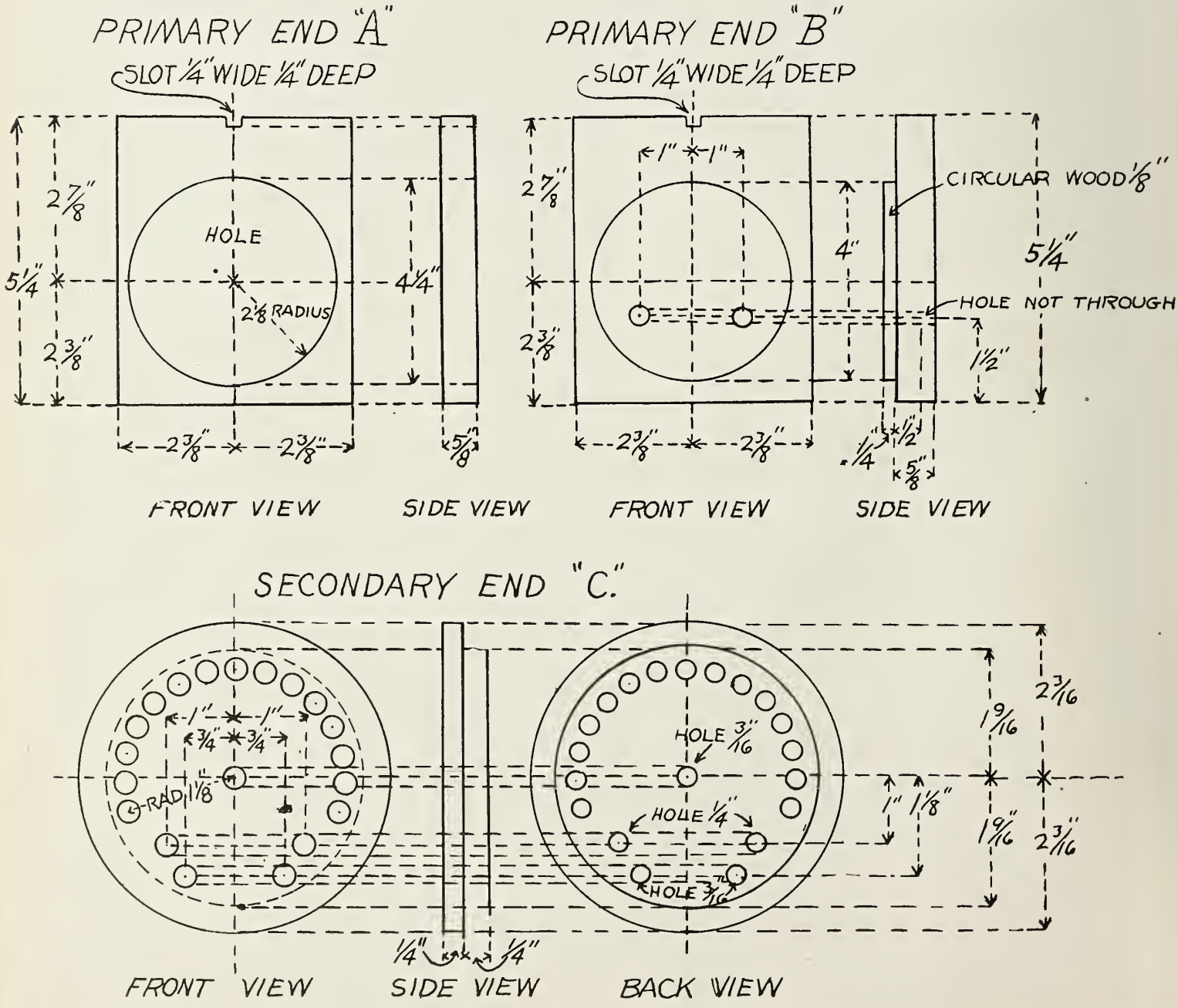


FIGURE 2.

Navy's Radio Shatters Distance

United States Stations Circle the Earth and Make It Seem Small

"HOW far is Paris—London—Berlin?

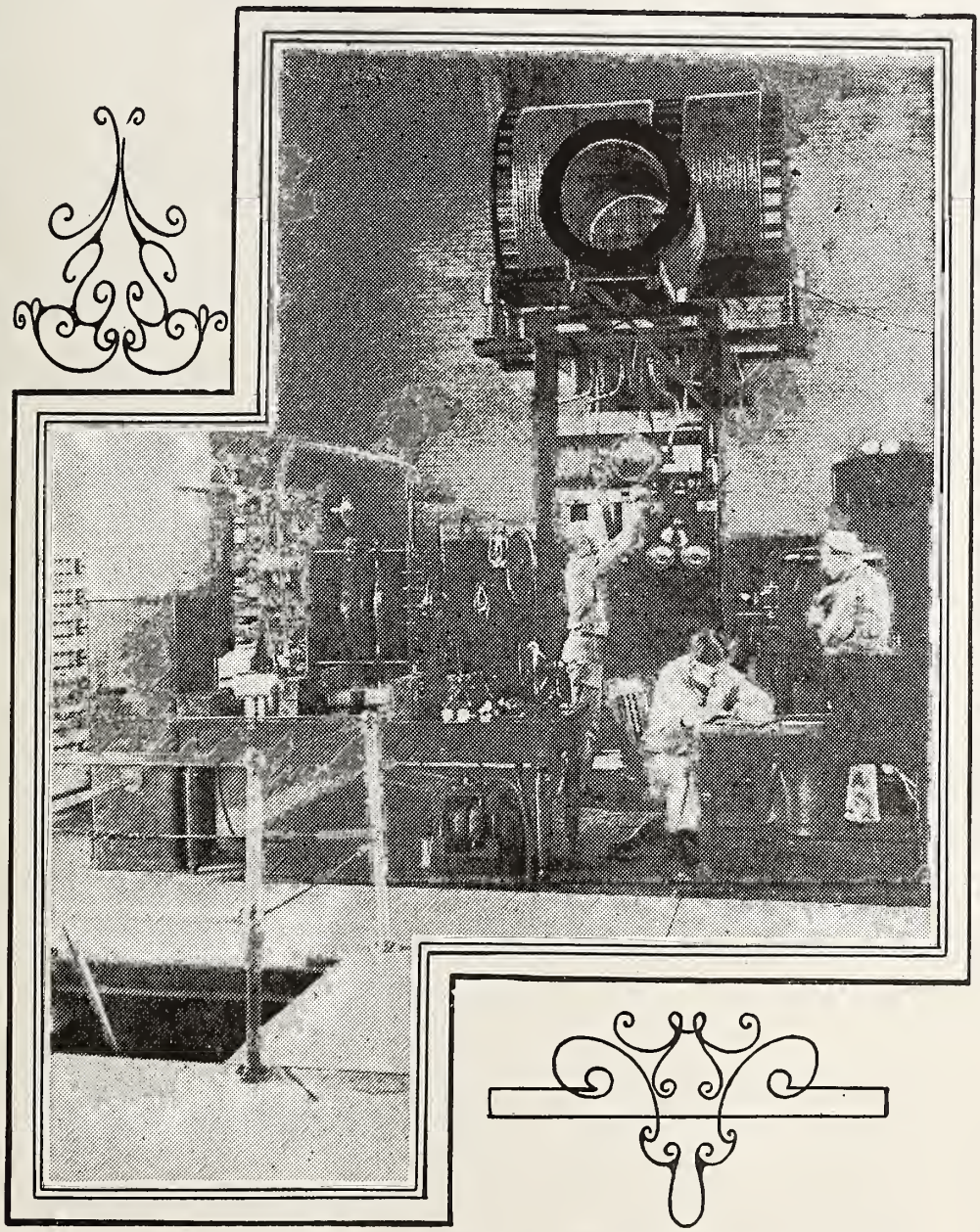
"The man in the street and the geography class answer in miles today," says a bulletin issued from the Washington, D. C., headquarters of the National Geographic Society, "but in a year, or even a few months, the answers may come in quarter-turns of a little black knob.

"For radio is affecting geography as it is affecting many other fields. If you can hear voices and music, and perhaps even the hum of traffic in the streets of a distant city, that city must straightway lose much of its remoteness.'' The bulletin continues:

"Even today, when radio telephony is in its infancy and radio telegraphy is merely a slightly older brother, our own country seems to be shrinking rapidly, and nations seem to be gravitating closer together. It is as though Europe and America, and presently the other continents, were being towed toward one another by tightening hawsers of ether waves. The capstan points for these ethereal cables—the great radio telegraph stations—take on a new geographic interest.

Cavite in the Philippines has been placed on the map by its radio station.

Wave lengths are not an infallible index to the power of a radio station nor to its sending range, but they indicate comparative strength at least roughly. The station which of all those in the world now regularly uses the longest waves—23,000 metres, or approximately 14 miles—is near Bordeaux, France. It is the Lafayette Station, built by the United States Navy to facilitate America's part in the World War, and since sold to France. This station, which until recently was unchallenged as the world's most powerful station, sends its telegraphic messages with ease—and practically instantaneously, of course—over the 4,000 miles of water and land that separate Bordeaux from Washington; and it has been heard occasionally in French Indo-China, 6,000 miles to the east.

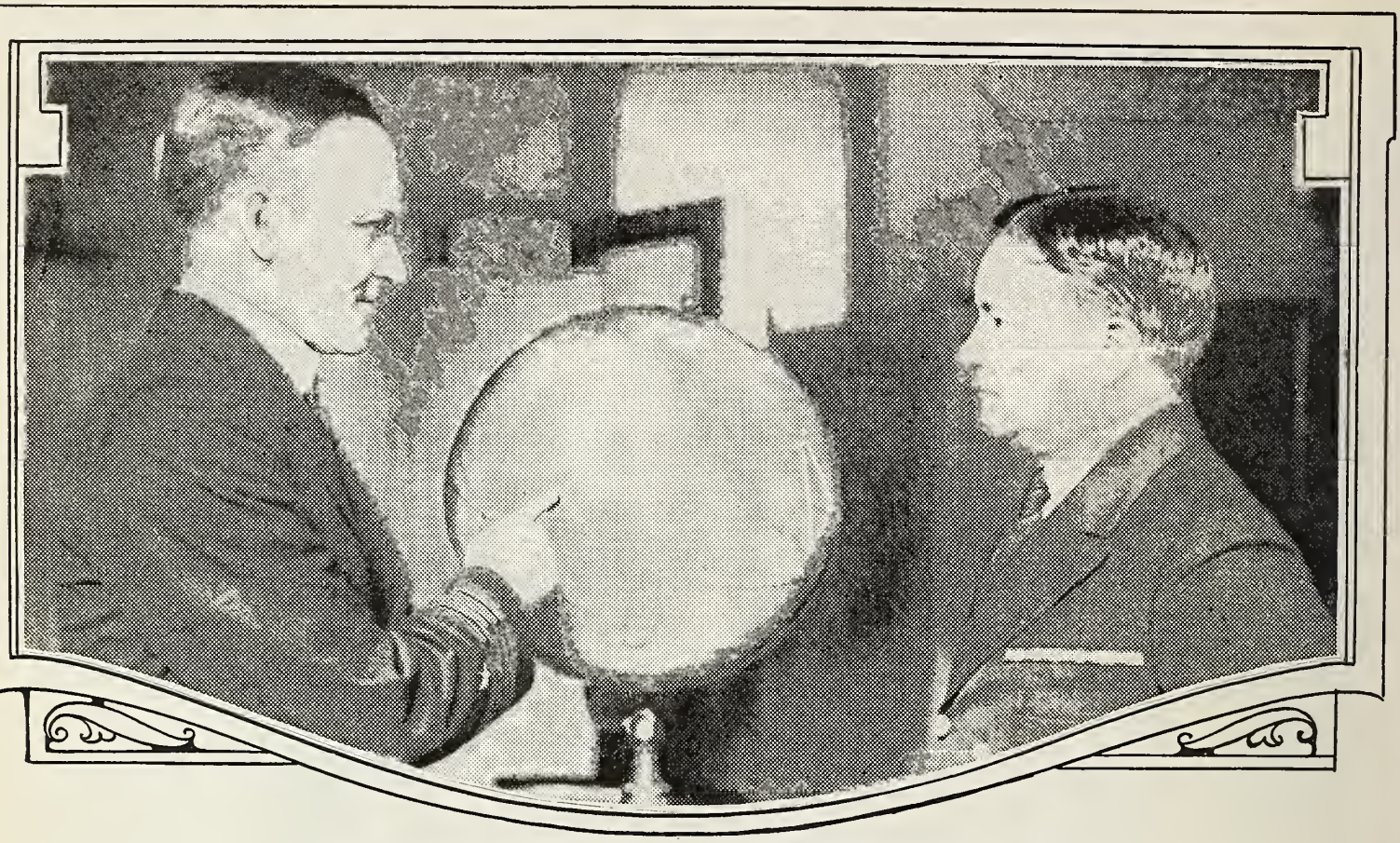


All amateurs know the naval radio station at Arlington. Here's a view of the interior of the powerful station

Lafayette's title to first place is now challenged by a commercial station recently opened on Long Island, which, if it is not yet more powerful, will be when additional units are added. This station sends on the second longest wave in use, 19,000 metres, or nearly twelve miles, and is employed for transmitting messages to Germany, about 4,000 miles away.

Although the United States Navy's station at Annapolis, Md., is assigned a wave of 17,145 metres (roughly 10½ miles), the third longest in use, it is easily one of the world's most powerful stations. For that matter, so is the navy station at Cavite, Philippine Islands, operating on 13,900 metres.

The navy depends on the Annapolis station—which is operated, incidentally, by remote control by means of keys in the Navy Building in Washington—to transmit mes-



The navy can flash a radio message to any part of the world at a moment's notice. Capt. S. W. Bryant, left, explaining the working of the chart globe to Commander D. C. Bingham, who has succeeded Capt. Bryant as director of naval communications. International News Reel Photo

sages day in and day out over a radius of about 5,500 miles. This range includes the extreme end of the Mediterranean Sea, and the same territory can also be reached from the opposite direction by the Philippine station.

The United States Navy has the most complete system of high power land stations for radio telegraphy of all naval establishments. Southward of the great Annapolis station it has among its larger units the sending plant at Cayey, Porto Rico, using a 10,510 metre wave, and another at Balboa, Canal Zone, sending on 10,-110 metres. The eastern portion of the Pacific is covered from the continent by a station at San Diego, Cal., and another on Puget Sound. The former uses waves of 9,800 metres and the latter of 7,100. In the Hawaiian Islands the navy has two sending stations, one using 11,500 metres and the other 8,875.

On Guam is a naval station which sends on 9,145 metres; and finally, in the Philippines is the 13,900-metre station which completes the navy's band of radio stations around the world. In practically no place where its ships are likely to cruise will they be out of range of dots and dashes from one or more of the navy's sending stations.

The British Navy does not maintain a system of land stations of its own but uses those of the British Post Office. These postal stations practically encircle the earth, but they do so in much smaller "jumps" than those of the United States Navy, and therefore use less powerful stations.

Other Long Senders

Of the twelve longest wave stations which follow Annapolis, seven are in the United States or its territories. They are commercial stations at Barnegat, N. J., 16,800 metres; St. James, L. I., 16,465; Kohoku, Hawaiian Islands, 16,300, and Tuckerton, N. J., 15,900; the navy station at Cavite, P. I., and commercial stations at New Brunswick, N. J., 13,-600 metres, and Bolinas, Cal., 13,310 metres. The five foreign stations in this group are British stations at Leafield, near Oxford, England, 15,-600 metres, and Carnarvon, Wales, 14,400 metres; a Dutch station in Java, 15,000 metres; a Japanese station at Iwaki, 15,000 metres, and a French station at Nantes, France, 18,800 metres.

There are only seven other important long distance stations using waves of 11,000 metres or more. They are Abu Zabul, near Cairo, Egypt, 13,300 metres; Nauen, Germany, 12,600; Lyons, France, 12,500; Stavenger, Norway, 12,000; Marion, Mass., 28,600; a station on the West Coast of India, 11,200, and Rome, 11,000.

The United States Army has numerous sending stations at its forts and posts scattered over the United States, which operate on wave lengths from a few hundred to 10,000 metres. The Post Office Department at its several stations sends oan waves for the most part between 1,000 and 4,000 metres long.

Service for Seamen

The Hydrographic Office and the Naval Communication Service collect and distribute hydrographic information by naval radio. The co-operation of owners, operators, radio companies controlling installations on board vessels, and masters is necessary to make this new undertaking a success. In return greater protection is afforded mariners than ever before.

High School Wins Radio Fame

By EDWARD I. TAYOR
One of the Boys in Chicago's Lane "Tech."

NOT far from the crowded loop district, yet situated ideally in the midst of Chicago's manufacturing center is the Lane Technical High School. Situated ideally, is the term used, for a school of this type where everything from aircraft drafting to the radio department assumes business-like proportions, becomes properly a part of the modern factories and business houses which surround it.

We will deal today with the radio department and electrical shops as space is limited and the story of this school would cover a thick volume. In the first place, Lane has been gifted with extraordinary talent both in its faculty and in its students. This in a way has helped to accomplish the results which are apparent on every hand, but something far more important is that of the feeling of school spirit which pervades the air and is quite contagious.

There is no issuing of sharp commands and orders by the teachers. Everything is well ordered and the students work with a zest which can only emanate from the interest each has in the work. It is the chief aim of every pupil to build a complete receiver for himself and learn the code in the radio class. It is not hard to imagine what a boy is apt to do under these circumstances.

Lane Technical High School held its annual military review the other day and conducted all the maneuvers through its student radio service. Major E. S. Pearsall gave orders in his office at the school by means of a sending set direct to the field of battle and the orders were relayed to the field officers by megaphone

If you have been fortunate enough to have gone through this school, you will remember your surprise in your first sight of the radio apparatus. There it stood on a table, resplendent in beautiful nickel plate, polished ebony, and rubbed mahogany. Perhaps you were one of the many who asked your guide what was the make of apparatus. When he told you that it was made, every bit, at Lane, you of course were surprised. And to prove his assertions your guide undoubtedly led you to the shops where construction of other receivers was under way. There you saw the boys winding the vario-meters and vario-couplers, drilling panels, making the cabinets, wiring the sets, and putting the finishing licks to outfits that could stand up alongside the best manufactured set on the market today.

The regenerative receiver made at Lane is a piece of apparatus which is modern and efficient in every respect. Beveled dials control the two variometers and the vario-coupler. A

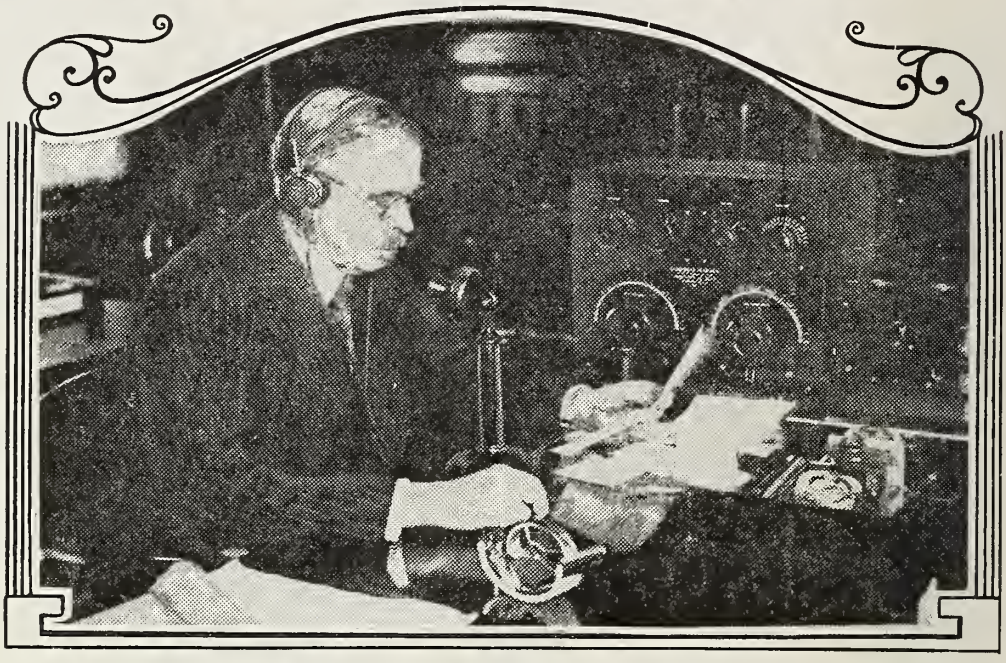
(*Continued on page 27*)

"Aerials" Under Ground and Under Water

Wartime inventor knocks out some theories about towers and static

THE latest advance in radio receiving was accomplished in April in the presence of four witnesses, when, with a coil antenna completely buried beneath the surface of the ground, vocal and instrumental music was clearly heard on a transmitted wave length of 360 meters over a distance of 220 miles. This successful experiment was accomplished in the field laboratory of Dr. J. Harris Rogers in Hyattsville, Md. The instruments used were a three-stage radio frequency amplifier and a loop antenna.

The far-reaching effect of this experiment will be the elimination of huge aerial towers for the reception of radio telephone or telegraph messages. As a climax to successful experiments which have assured the reception of long radio telegraph waves on underground antenna, the test just performed demonstrates the possibility of regular radiophone communication without areial wires above or on the surface of the ground. This removes the present limit of underground radio receiving systems, namely, the reception of short wave lengths which today represent the bulk of commercial short distance radio traffic.



Postmaster General Work is shown in his office listening to radio reports. He insists on having a receiving outfit in his own office.

Eliminates Static

Not only the message from KDKA and WJZ were clear and distinct in themselves, but in the presence of severe static, street car and train lines less than 200 yards distant, none of these disturbances interfered with the perfect reception of the transmitted messages. This means that in mines, dense forests, in arid wastes and under severe static conditions present in extreme north or south latitudes, a hole in the ground will suffice to contain the antenna necessary to receive messages transmitted thousands of miles away and at wave lengths heretofore not approached.

J. Harris Rogers, Civil War veteran, inventor of the printing telegraphs, synchronous motors and other devices, is the discoverer of the underground aerial receiving system.

In 1916, during the war period Secretary of the Navy Daniels immediately facilitated the securing of patents which protected the discovery of Dr. Rogers and established stations at Great Lakes, New Orleans and Belmar, N. J., for experimenting with and developing the Rogers system. Meanwhile in Hyattsville, Md., Dr. Rogers and Government officials listened in from the little hut named Mount Hooper in honor of Admiral Hooper, U. S. N., situated three miles in the woods beyond Dr. Rogers' home.

Messages from France

Trenches were dug and wires buried in all directions and at varying depths, the effect being similar to the spokes of a wheel offset from the center.

A wire 4,000 feet long encased in a tile pipe three feet below the surface of the earth was stretched in a westerly direction. Communications between German army units on the European battle front were clearly heard. The apparatus consisted of a large tuning coil, a variable condenser, one step audion amplifier, and two pairs of Baldwin head 'phones.

With this equipment and underground aerial the officials heard regularly Nauen, Germany; Eiffel Tower, Paris, and all United States stations on long waves. Not only were these stations copied regularly but simultaneously stations employing the Rogers system at Belmar, N. J., and Great Lakes maintained continuous trans-Atlantic receiving service.

"Aerials" Under Water

The Belmar, N. J., station was in operation twenty-four hours a day; not a single word was lost during the transmission of thousands of messages. A submarine submerged eight feet off the Atlantic coast heard Nauen, Germany; twenty-one feet submerged it heard distant stations on 12,000 meters wave length. A transmitting station operating with forty-eight amperes antenna current 600 feet away from a receiving station, using the Rogers underground aerial system, did not interfere with Nauen being picked up on 12,600 meters and New Orleans on 5,000 meters. No interference and no static. Aerials far under water were used to receive Cavite, Philippine Islands, 8,100 miles distant, on its regular 11 a. m. and 5 p. m. schedules.

Transmitting experiments with the Rogers system have been successful over a distance of seven miles; longer transmission is as yet not fully developed because it is found that insulation material now used will not stand the excessive currents used in transmission, says the Washington Herald. But today radio telegraph and radio telephone messages may be received over long distances and over very low or very long wave length ranges with antenna buried beneath the ground or submerged beneath the seas.

Electric Light Wires as Auxiliary to Radio

THE B battery heretofore so essential to every radiophone-receiving set for maintaining the plate potential will no longer be needed when an arrangement made by the Bureau of Standards becomes generally practicable. The new development makes direct connection to the electric light socket possible. By special modes of connection, the lighting wire may also be used as an antenna.

The warning given some weeks ago when this method of reception was suggested in connection with the work of Maj. Gen. Squier is repeated: Novices should not attempt any meddling with lighting circuits, hoping to avoid the erection of an antenna or eliminating the storage battery. The new development is practicable only with the proper plug equipment and some knowledge of the principles involved.

The receiving set consists essentially of an amplifier with minor auxiliary parts. This is described in a paper which has been prepared by the Bureau of Standards. A few details of the amplifier, which utilizes 60-cycle current supply for both filaments and plates of the electron tubes, are as follows: This amplifier has three radio-frequency stages and two audio-frequency stages, and uses a crystal detector. The 60-cycle current when used in an ordinary amplifier circuit introduces a strong 60-cycle note which offers serious interference. This has been practically eliminated by balancing resistances, grid condensers and special grid leaks of comparatively low resistance, telephone transformer in the output circuit and crystal detector, instead of electron tube detector.

In the final form of the amplifier there is only a slight residual hum which is not objectionable. The amplification obtained with a. c. supply was as good as that obtained with the same amplifier used with d. c. supply. The complete unit is light, compact and portable. For the reception of damped waves, the amplifier as constructed operated most satisfactorily for wave lengths from 200 to 750 meters. This range was determined by the working range of the radio-frequency transformers used. By using suitable radio-frequency transformers it is expected that the amplifier will be effective for the reception of damped waves and undamped waves as long as 10,000 meters. For the reception of undamped waves a separate heterodyne should be employed, the paper says.

During the war experiments proved that it is possible to use trees instead of the usual antennae for wireless receiving outfits. These two Atlantic coast boys are giving the trees a chance to speak. Press Illustrating Service Photo

New Stuff by Boy Readers

By Edwin Nielsen

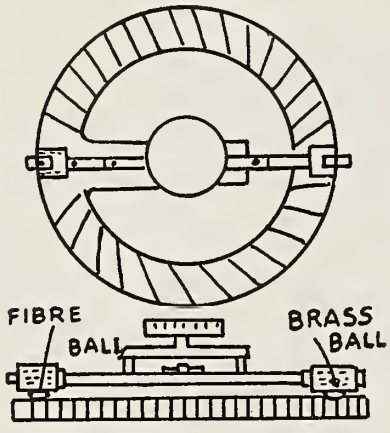
DO YOU have trouble in getting loud signals on your crystal detector set? Why not use a crystal amplifier in one or two stages simply by connecting one or two crystal detectors in series with your original crystal detector, using an amplifying transformer and a 22-volt B battery as shown in the illustration. This will enable you to get loud signals where only weak ones were formerly heard, will greatly increase your receiving range and will enable you to use a loud speaker horn instead of your phones, thus allowing the whole family to listen in, where before only one could listen at a time.

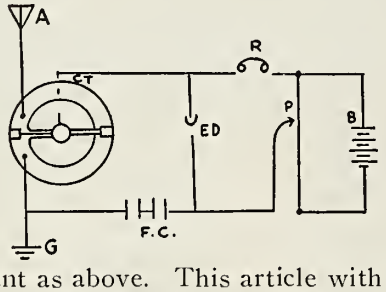
This idea had its origin in the brain of a South American amateur, who has organized the first if not the only Radio club in that part of the world. And I have tried this type of amplifier and had the signals far exceed my hopes in loudness and clearness of tone.

To get good results it will be necessary to get very sensitive crystals and place the catwhisker wire on the most sensitive place that can be found, the crystals can be tested by connecting a buzzer, battery, a key and a coil of about 10 turns together, as shown in the illustration; this coil is placed as close as possible to the tuning coil of the receiving coil and the key is pressed. This sets up miniature radio waves which are caught by the receiving coil and carried over to the detector where the crystal to be tested is mounted. The catwhisker is moved around until the best spot is found. The other crystals can be tested in the same way. If no buzzing is heard in the receivers while the crystal is being tested another crystal must be used.

Beginners Need This

A number of requests have come to the editor asking how the reader could secure the plans of a homemade receiving set published by the Bureau of Standards in Washington. The editor is in receipt of a letter from that department saying that, owing to the great demand, the department is unable to furnish any more free copies of the lessons, but will publish them as Bureau of Standards Circular No. 120, which may be secured by writing the Superintendent of Documents, Government Printing Office, Washington, D. C., and giving the number of the document as above. This article with illustrations was a feature of the May issue of Radio Age. Copies of that issue will be mailed on receipt of 25c in stamps by Radio Age.





Red Cross Radio

The American Red Cross is considering the use of radio as an aid in its emergency work. At the radio exhibition in Boston a radio set with a receiving radius of 2,000 miles was in operation for the reception of first aid calls, which were answered by nurses in attendance at the Red Cross booth in the exposition hall.

By Joseph Stelzer, East St. Louis, Ill.

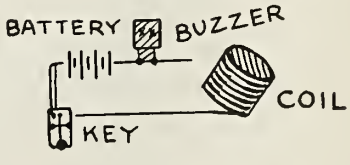
THE rotary tuning coil shown in the one-column sketch gives the complete wiring diagram. The circle is cut from ¾-inch stock, 1 inch wide, and well covered with insulation. It is then wound with No. 24 single cotton-covered wire so that the coils will lie flat.

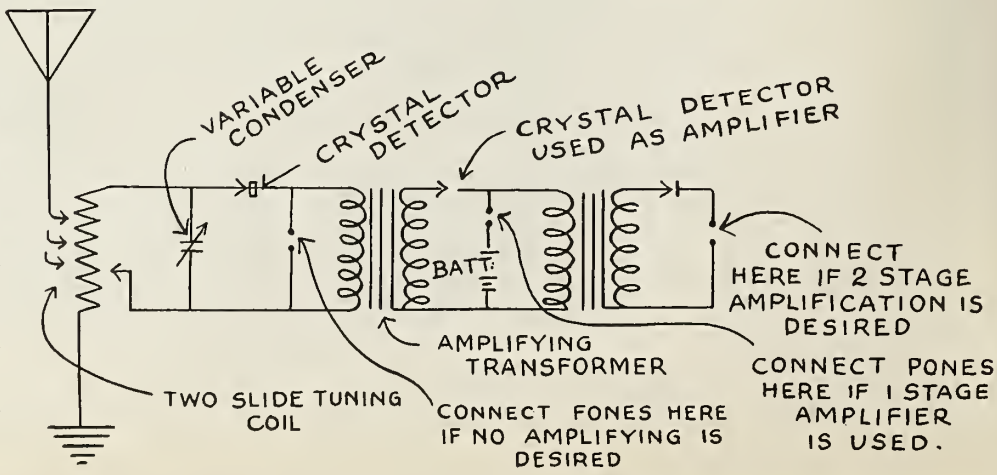
All of the arms are ¼-inch square and are of brass. The supports are smaller in section. Slides are mounted on the ends of the long arms and are kept in place by set screws. The insulation on the wires is removed with a small piece of sandpaper pasted on a block of wood.

This should be temporarily fastened to the revolving lever at the point where the contact is wanted; then the lever is turned until the insulation is removed. The wiring diagram shows the location of the tuning coil in the line.

Trying the Voice

In an address before the Chicago Rotary Club, Morgan L. Eastman, with the aid of pictures and radio apparatus, showed how the voices of singers are tested before they are used for broadcasting purposes. Mr. Eastman devised a microphone, which was worked out by Westinghouse engineers, so arranged that a listener may determine whether a singer in an adjoining room has a voice of the proper carrying quality. Mr. Eastman is in charge of the Westinghouse broadcasting station KYW on the Commonwealth Edison building, Chicago.



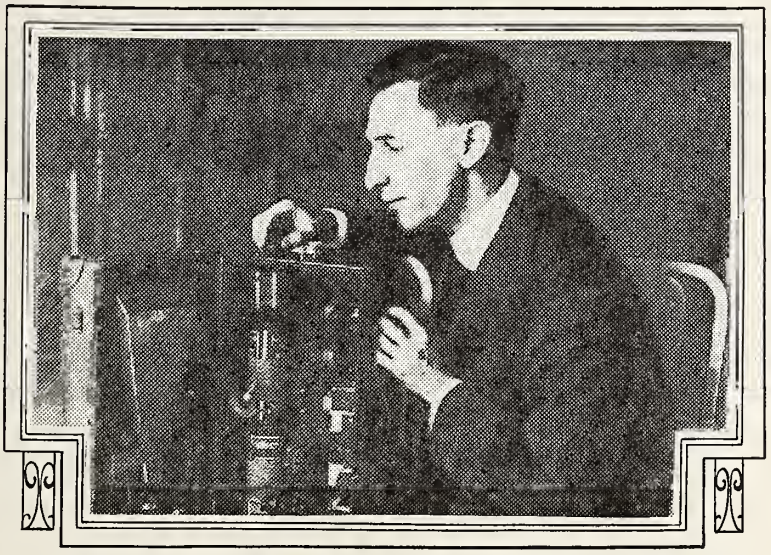

VARIABLE CONDENSER
CRYSTAL DETECTOR
CRYSTAL DETECTOR USED AS AMPLIFIER
BATT.
CONNECT HERE IF 2 STAGE AMPLIFICATION IS DESIRED
AMPLIFYING TRANSFORMER
CONNECT PONES HERE IF 1 STAGE AMPLIFIER IS USED.
TWO SLIDE TUNING COIL
CONNECT FONES HERE IF NO AMPLIFYING IS DESIRED

In Radio Shops and Factories

ASSOCIATIONS of manufacturers and merchants in the radio trade are becoming the order of the day. The solid element in the business recognizes that it is necessary to mobilize against the wildcat promoters who are in radio purely for stock-rigging purposes or who are in it to shove off a lot of rotten equipment while demand is feverish and prices are tempting.

While the sheep are being separated from the goats it is advisable for the public to step warily, dealing with established firms who have sufficient business standing to insure their handling good merchandise. At present the demand far exceeds the supply and the fellow who is in the business for a "flyer" is occasionally doing about as well as the fellow who is in business because he means business.

It was stated by one of the speakers at a recent important Chicago radio conference in Hotel Sherman that the supply situation was being straightened out rapidly and that within sixty days the "sold out" signs would have to be taken down. When that time comes the merchant and manufacturer who have been selling honest goods and exploiting their name and their wares and building a future will still be there making money. The other man will have nothing but ap ast.



F. W. Dunmore, of the radio laboratory of the U. S. Bureau of Standards, brought a "singing valise" to the Drake Hotel in Chicago on April 20. He had a radio receiving set in the grip, with a folding loud speaker. As he walked about the lobby, music and news reports came from the valise. His ground and aerial wires were cleverly concealed and gave him a limited radius of travel with his magic grip.

Among the new organizations is the National Radio Chamber of Commerce, with headquarters in New York City and district office in Chicago. Alexander Eisemann of the Freed-Eisemann Radio Corporation is president. Mr. Eisemann says:

"The object of the association is to remedy certain conditions which have arisen in the radio industry as a result of its tremendous growth within the last few months; and to group together manufacturers whose radio products are of such dependable character as to maintain favorable public opinion toward the radio industry.

"All radio manufacturers, whether large or small, will be eligible for membership. Our original group consisted of about fifteen manufacturers. To those have been added, by invitation, about twenty additional concerns whose business standing and whose products are known to be of high order. New concerns will be eligible only after their apparatus has been passed upon by a board of five members.

"It is planned to exclude from membership various concerns which have been organized purely for stock jobbing purposes, and to exclude also manufacturers who are now turning out radio apparatus which has been found to be untrustworthy and which will eventually bring radio into disfavor on the part of purchasers of such undependable apparatus.

"A credit bureau will also be organized shortly for the interchange of credit information."

Other officers of the organization are Charles Keator of the De Forest Radio Telephone and Telegraph Company, William Dubilier of the Dubilier Condenser Company and Frank Hinners of the Home Radio Company.

* * *

The investigating committee of the Radio Conference of the National Retail Drygoods Association, in session in New York, considered the quality and efficiency of radio apparatus and the possibility of service in the distribution of such merchandise.

As its first recommendation the Investigating Committee adopted a resolution, "That all responsible manufacturers be requested to standardize the efficiency of their various receiving sets and plainly mark on each instrument the receiving radius under average atmospheric conditions."

* * *

The manufacture of radio apparatus in Washington, D. C., has grown to extraordinary proportions. The Radio Instrument Company and the Washington Radio Corporation have completed arrangements for building factories immediately.

* * *

Officials of two leading electrical companies in Chicago estimate that from 2,000 to 3,000 dealers have gone into the radio business in Chicago during the last two months.

* * *

Charles T. Powner, bookseller, has a radio department in his shop at 177 West Madison street.

* * *

Among other big Chicago concerns that may soon be on the list of makers or sellers of radio devices are Lyon & Healy, Sears-Roebuck and Brunswick-Balke. Hundreds of drug stores, furniture shops and department stores are laying in radio stocks.

* * *

The Scientific American says there is a widespread opinion that the radio business will outstrip the phonograph business, which has been in excess of 400,000,000 per year.

* * *

It is estimated that the monthly production of vacuum tubes is about 100,000.

All through the Mississippi Valley an interesting phenomenon is being observed. Otherwise modest and humble citizens appear on the street with their chin in the air and a proud glint in their eye. There is nothing wrong with these fellows. They merely have succeeded in getting Schenectady for the first time. How can they be expected to remain in the same social stratum with the plodder who has picked up stuff from no greater distance than Detroit or Indianapolis?

Summer Static and How to Meet It

SAY "static" to a radio enthusiast and listen to what he says, or else cover your ears. His opinion of the greatest nuisance which besets radio telegraphy and telephony will no doubt be fervent if he is an experienced operator. If he is an amateur, it will be despairing.

When a radio fan talks of "static" he means the small charges of positive electricity which infest the atmosphere, forever seeking an outlet to the negative earth. They are in effect miniature bolts of lightning which have not the force to strike under their own power. Hence they seek assistance, which is unwittingly extended to them by the aerial of the radio apparatus. By means of this they find a ready passage to the ground, where they cease to be troublesome.

But woe to the amateur whose aerial is not well "grounded." Balked of their goal, static charges have been known to start fires. Even greater is the danger during a thunderstorm, unless a good ground wire is provided. Any ground installation which complies with the underwriters' requirements will furnish adequate protection, however, against this. It is always advisable to stay away from wireless apparatus during a storm.

Commencing with the next few weeks, radio operators and amateurs will encounter static with increasing frequency due to the approach of warm weather. Static is more abundant in summer than at any other time of the year, making it extremely difficult for the average radio enthusiast to operate his set.

The cause of this trouble is sometimes in the use of an aerial that is too lengthy. No aerial for receiving broadcasts should be more than 150 feet in length. Where a two-wire type is used, the length, including the lead-in wire should not exceed sixty-five feet.

Where a station is located near a broadcasting center, indoor aerials will be found superior in summer. These may be made in the form of a grid or coil, either mounted on an insulated stand, or attached to porcelain insulators fixed in the beams of the attic of the house. This device is only for use in houses where metal roofing is not employed. All wires must be kept as far as possible from the lighting system wires of the house. Vacuum tubes are imperative in using this type of aerial, but their expense is offset by the resultant freedom from static.

THE WIRELESS CODE

1. A dash is equal to three dots. 2. The space between parts of the same letter is equal to one dot. 3. The space between two letters is equal to three dots. 4. The space between two words is equal to five dots

Period .. Semicolon .. Comma .. Colon .. Interrogation .. Exclamation point .. Apostrophe .. Hyphen .. Bar indicating fraction .. Parenthesis .. Inverted commas .. Underline .. Double dash .. Distress Call .. Attention call to precede every transmission .. General inquiry call .. From (de) .. Invitation to transmit (go ahead) .. Warning—high power .. Question (please repeat after .....)—interrupting long messages .. Wait .. Break (Bk.) (double dash) .. Understand .. Error .. Received (O. K.) .. Position report (to precede all position messages) .. End of each message (cross) .. Transmission finished (end of work) (conclusion of correspondence)

The curious fact that so-called "air-pockets," impenetrable to wireless telegraph or telephone waves, exist in the atmosphere was commented on recently by F. B. Chambers, a Philadelphia authority on radio matters.

"There are three well-known 'pockets' here in the east," said Mr. Chambers. "One is near Pittsburgh, another somewhat north of New York city, and the third in the gulf of Mexico.

"The Pittsburgh one covers an area about a mile and a half square. The New York one is the largest, being fifty miles in extent. Many theories are offered to account for these strange phenomena. The most plausible one is that there are certain strata of minerals underlying them which deflect the wireless waves off at a large angle. The question of their origin, though, has never been satisfactorily solved."—Philadelphia No. American.

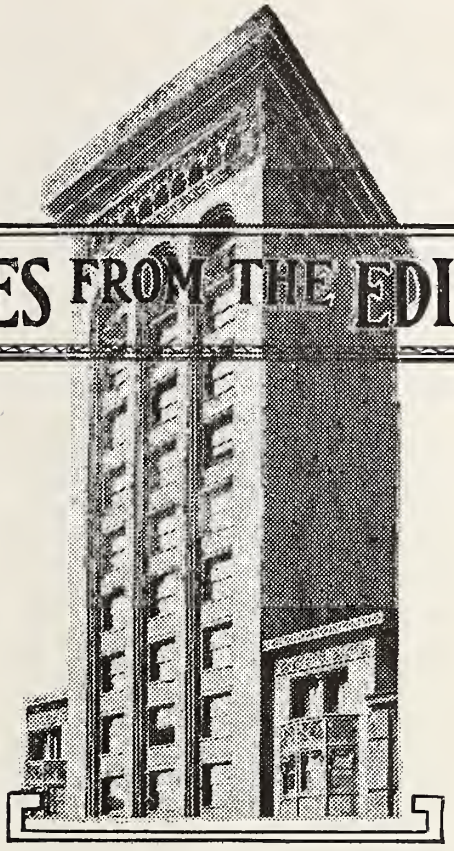
National observers say that new radio factories have helped take the edge off the unemployment situation.

Learning the Code

A practical method devised for mastering the code at home is to be found in the set of six Victor-Marconi records which reproduce on the phonograph the international Morse Code characters exactly as they are heard by wireless. There are twelve lessons, which carry one from the novice to the expert stage.

River Affects Waves

Fletcher H. Hiles of Cincinnati, a steward on the Big Four limited, running between Cincinnati and Cleveland, is perfecting a system of intercommunication between trains by means of radio telephony. He has been picking up concerts, also, while the trains are at top speed. At points where the track parallels a river the receiving is fine, but goes dead when the tracks are at right angles with the river.



THOUGHT WAVES FROM THE EDITORIAL TOWER

STRANGE, indeed, that people should still be asking the question "Is radio merely a passing fancy?" Only the other day the International News Reel Corporation dug up from musty records in England papers showing how a receiving set had been made in 1879 with detector, condenser and all the fundamentals of the "newly discovered devices" now engaging the fascinated attention of at least one and one-half millions of persons in America alone. Not only that, but the receiving plant itself was found with the papers and the interesting display has been placed on exhibition in a British museum.

Marconi was doing his wireless stunts before the boy radio enthusiasts of today were born. DeForest and Fleming and Edison were making the Hertzian waves perform practical service for the world a decade or longer ago.

Well, then, why the sudden towering wave of interest in radio? Simply this, that broadcasting stations have been established which send forth to the uttermost corners of the earth not only messages in the wireless telegraph code, but music, speeches, market reports, weather predictions, baseball scores and news of the present hour.

It is the broadcasting station and the development of the vacuum tube for detecting wave lengths and clarifying the vibrations in the phone diaphrams that have made the radiophone an implement of universal entertainment and utility.

Men, women and children who took only a fleeting interest in a device which enabled them to hear unintelligible Morse code signals are aroused to intense and permanent enthusiasm over an inexpensive and simple device that brings the great outside world to their dining room tables and to the cosy corners of their living rooms.

That is why radio has become so suddenly "popular," and that is why the present interest is surely the forerunner of continued developments in radio. These developments will bring radio to every-day uses which eventually will effect a peaceful reorganization of our social and business life. Radio is rapidly moving forward to new uses which even the alert imagination of Edward Bellamy could not reach in his famous story, "Looking Backward."

Dissemination of news by radio is going to be systematized to such an extent that it will make a great difference in the status of the daily press. It is perhaps true that some of our great daily journals look with apprehension at the advancement of this science and its adaptability to broadcasting news facts to the millions. That may explain why some of them are giving the radiophone the most indifferent attention.

One great newspaper, so substantial that one might almost be tempted to describe it as "solid," said the other day that a layman might wind a tuning coil, but that the operation would require extreme patience and that he would find it to be a "man's job." Rather amusing when you and I know scores of neighborhood boys who can wind a tuner in fifteen minutes!

They have harnessed Niagara, but they are never going to stop the headlong rush of radio into universal popularity and utility. And it is going to be a giant task to make it a privately controlled public utility. Millions upon millions of dollars have already been invested in this new industry and no man can keep account of the new manufacturing and merchandising organizations that are springing up each day.

In a few days we shall have the golf player getting his market and sporting news between games, sitting comfortably in his country club chair. Hotel lobbies, flats, apartments, automobiles, trains, aeroplanes, farm houses, garages, schoolrooms, lighthouses, ships, newspaper offices, police stations, police call boxes, prisons, hospitals, churches, theaters, restaurants, department stores, factories, fishing camps, hunting lodges—they are coming into line more rapidly than you or I realize.

It is the hour of radio. If it is a passing hour it is a passing hour that is advancing to yet another hour which shall be more electric with surprises, more fruitful of progress for the human race, more annihilating to geographical distances, and more effective in weaving all peoples into a closer association. That promises the ultimate in civilization.

Radio is neither a fad nor a craze. It is a stupendous social revolution.

EVERY breeze that blows brings some new tale of extravagant success or impending disaster in the radio industry. After sifting the product of the rumor mills we have come to the conclusion that the radio business is merely stabilizing itself, as every new industry must do.

Undoubtedly there are unscrupulous manufacturers and dealers in the game. They are trying to get a quick dollar and make a quick withdrawal before their sins of misstatement and of inferior merchandise overtake them. But there are many, many more manufacturers and dealers who are sincerely trying to establish a permanent, solid radio business on merit.

Undoubtedly there are large interests which would eagerly assume control of radio production and sales. Undoubtedly there are some interests which would gladly adopt the

threadbare method of restricting supply in order to maintain exorbitant prices. But there are too many enthusiastic, wideawake American men and boys watching the situation to make it discreet for even a giant to get in the way of the steam roller.

It would be best for radio fans and best for the radio "big four" to insist upon and get an early threshing out of that charge by Representative Brittain of Illinois to the effect that the combine is restricting by some mysterious influence the placing of millions of dollars worth of tubes on the open market. Mr. Brittain insists these supplies should be sold to the public inasmuch as the government holds a sufficient supply to last the army and navy "several hundred years."

Whatever are the facts, they will become public in due time. Meanwhile there is no need to leap at conclusions.

Another tale that comes into the editorial sanctum relates to a plan by which a large manufacturer will establish broadcasting which shall be so "scrambled" that it will be impossible for any person not owning a receiving set sold by that manufacturer to get the stuff and unscramble it. That is, the receiving apparatus will be so adjusted that it will form a complement to the sending apparatus.

The story seems absurd on its face, but intelligent radioites are seriously discussing it. The majority of them seem to believe that any such attempt at monopoly of a public utility would be defeated promptly by an honest government.

We also hear of a large concern that is sending out letters to prospective buyers of expensive equipment advising them to hold off a few months, as there is something new coming into the market that will make all present receiving equipment out of date and useless. More power to invention! Let the wave wave on!

And then our friends drop in and tell us with long faces that summer weather is not conducive to good radio transmission. Therefore look out for that slump! Good old slump, the bogey man of the radio trade! It might be well to stop and consider that hot weather does not, as a matter of simple fact, seriously interfere with reception of radio waves at ordinary distances. The boys who are getting messages and concerts from broadcasting stations in their vicinity today will be getting the same results on August 1. Of course, for those who want to hear messages from Germany or Hawaii, warm weather will cause disappointment, but the mass of radio enthusiasts will scarcely detect any difference in their ordinary radio pursuits.

Merchants who have been stocking up with large consignments are supposed to be frightened by these hot weather stories, just as are the sea bathers by the annual yarns about sea serpents and sharks.

Finally, let us be optimists. Those radio merchants and manufacturers and those radio publications which are trying their best to get solid business on solid business principles are going to achieve their just reward. Anybody who is afraid of shadows has no business in the field. Roosevelt's advice is as good now as it was when he uttered it: "Speak softly and carry a big stick."

* * *

Since going to press on our previous edition we have been solemnly assured by the newspaper scientists that they have discovered that cockroaches flash radio messages to one another. We also learn that the lightning bug's lightning and the glowworm's glow and the ant's antennae are all a part of the radio game. We should not be surprised if these scientists had proved by the time of our next issue that the mosquito, in thrusting its rapier into our skin is merely looking for a ground. Also that the office boys who whistle into our ears as we pass along the busy streets are involuntary and unconscious broadcasters; that the porcupine is a perfect detector and the house cat makes a loud speaker when hooked into the receiving system. When the Milwaukee broadcasting stations are particularly active, it is said that near-beer is transformed into the five-per cent stuff, due to the extreme sensitiveness of malt liquor to anything that has waves in it. We agree also that girls who still have hair enough to harbor hairpins may just as well as not use a hairpin for an aerial and false teeth for a receiving Ain't science wonderful?

* * *

We know a youth who made a receiving set from the directions printed in the May number of Radio Age. He paid $3.85 for materials and dug up an old telephone head-set and from the first day was able to get the baseball and market reports and the concerts. Within ten days he had expended $105 for additional parts to make his outfit a regular humdinger. That's the way this radio gets 'em. After listening to the home broadcasting station a few days they want to listen to coolie conversations from Wuhu, China.

Railroad Radio

OFFICIALS of the New York Central Railroad and of the research department of the American Telephone and Telegraph Company are studying conditions with a view to using radio in the handling of trains and of the railroad tugs and other craft that ply about the New York harbor.

According to the Central's program the wireless telephone service would be used in train service not only for communication between the head and rear ends of 50 to 100 car freight trains, but also between moving trains and dispatchers' offices or other fixed stations.

"Such use would be valuable in the operation of the railroads," says the current issue of the company's magazine in announcing the plan, "especially for communication between the front and rear of freight trains, some of which are now a mile long. In the event of anything getting out of order on such a train while it is running, the ability of the conductor to communicate almost instantly with the engineer would be a most valuable adjunct to the present methods. In handling the New York Central fleet of tugs and other boats—this carrier's fleet numbers 306 units—the use of the radio telephone would be particularly worth while in time of heavy fog or other emergencies."

In course of time, officials believe, a passenger will be able to go to the observation or club car on the Twentieth Century Limited and put in a call, while riding over the lines, for his office at New York to issue orders regarding business transactions; or for his residence, perhaps, to tell his wife that he forgot some of his wardrobe and have it forwarded on the next train.

* * *

The Pere Marquette railroad has under consideration the equipment of fifty miles of its road with a new system of wireless train control, which has been invented by a Detroit man.

* * *

The Lackawanna operated a special train from Ithaca, N. Y., to New York City, on April 5, the train having been equipped with both sending and receiving apparatus. The passengers were Corsell students. During the entire run communication was maintained with several amateur stations and special programs were received from two broadcasting stations.

* * *

The Chicago, Milwaukee & St. Paul road has installed receiving sets on the Pioneer Limited.

The Radio Club of Illinois

By BARRATT O'HARA
One of the Directors of the Club and Former Lieutenant Governor of Illinois.

CHICAGO is out to lead the world in radio. From early summer until late autumn the metropolis on the lake is to be turned over to the pioneers in what Mayor William Hale Thompson declares is an industry that will surpass in magnitude anything the world has ever known. The mayor, the city council and the leading business and professional men of the city have united in putting Chicago in the race to become the world's radio capital.

"No one can even dream how rapidly the radio industry will grow," said Mayor Thompson. "Chicago is now the third largest city in the world. If we can center the radio interests here, within five years Chicago will be the largest city in the world. So far from believing that radio is a temporary fad, we in Chicago are so convinced of its permanency and importance that we are willing to let our dreams of leading the cities of the universe in population rise or fall with the radio industry."

The first step in Chicago's campaign was the organization of the Radio Club of Illinois. Starting with a $125,000 club house at 4220 Sheridan Road, in the finest section of the city, the Radio Club of Illinois almost overnight took its place among the best of many magnificent social club organizations of Chicago.

Mr. Schmitt Is President

It was fortunate in its selection of a president, Lawrence B. Schmitt, the government inspector for radio in the thirteen middle western states, being unanimously elected to head the club during the first year of its existence. Mr. Schmitt is a young man of thirty, full of pep and enthusiasm and one of the best authorities on the wireless in the country. He is extremely popular among radioists throughout the extensive district that he serves. Col. John P. Tansey was made secretary of the club. Among the directors elected was Alfred Thomas, Chicago manager for the Radio Corporation of America. All persons interested in the wireless are eligible in membership, the aim of the club being to furnish the technical, professional, commercial and amateur radioists a common meeting place, with extensive privileges and conveniences usual with first-class clubs. The club is the center of the radio activities of Chicago, and its influence in the crystalization of sentiment back of needed radio legislation is probably destined to be second to no organization or group.

The club is in charge of an international radio congress to be held in Chicago during the first week in August in connection with the Pageant of Progress. Delegates from every state in the union and many foreign countries will participate in the Congress, at which subjects of vital interest in the industry will be discussed by such authorities as Steinmetz, Armstrong and Secretary of Commerce Hoover.

Inspector L. R. Schmitt

Mexican President Coming?

As indicating the widespread interest in the congress outside of Chicago it may be mentioned that President Obregon, of Mexico, who is a great radio fan, has intimated his intention of attending as the head of the Mexican delegation. Invitations have been sent to the governors of all the states to attend as the chairmen of their respective state delegations, and it is not unlikely that most of them will accept.

An interesting feature of the congress will be sessions devoted to the boy radioists. This will be presided over by one of their own number, possibly the young son of Secretary of Commerce Hoover. It is reported from Washington, on authority that seems to be reliable, that Mr. Secretary Hoover's final arbiter on all delicate radio questions is his son. The boy knows radio from start to finish. He is called into every conference on radio held in the official offices at Washington. He will attend the congress with his distinguished father, and it is more than likely that the boy radioists will call upon him to preside over them.

Mayor William Hale Thompson and Dr. John Dill Robertson, president of the Pageant of Progress, are naturally taking a keen interest in the success of the congress. They are ex-officio members of the executive committee of the congress, consisting of City Electrician George E. Carlson, chairman; Col. John P. Tansey, secretary; George B. Foster, vice-president of the Commonwealth Edison Company; Lawrence B. Schmitt, U. J. Herrmann, Dr. W. A. Evans and Barratt O'Hara. This committee will meet weekly on Monday evenings at the offices of the Pageant of Progress, 7 West Madison Street.

Personnel of Committees

Radioists with suggestions to make for the success of the congress will be welcome at any of the meetings of the committee. Barratt O'Hara was made chairman of the publicity committee, the other members of which are Frederick Smith, editor of Radio Age; W. G. Wunderlich, editor of Radio Topics; G. H. Jaspert, in charge of radio in the Chicago office of the Westinghouse company; W. S. Hedges, radio editor of the Chicago Daily News; Charles Sloan, radio editor of the Chicago Daily Tribune, and William J. Clark, radio editor of the Chicago American.

Interesting programs have already been outlined for radio meetings that will mold radio history.

Questions and Answers

Conducted by FRANK D. PEARNE

C. H. N., Belleville, Ill.

Question: Am making a radio set according to the lesson prepared by the U. S. Bureau of Standards, and am puzzled in putting up the antenna. The only way I can run a 75-foot wire is by erecting a support, which I do not wish to do if there is another way. Can I run the wire around the four corners of the roof or can I run several wires parallel to each other, and how far apart should the wires be? Do you think a loop will work satisfactory, and how is it made?

Answer: It is not so much a question of whether the aerial will work or not, but how well it will work. Almost any kind of an aerial will work, and you must remember that you are trying to work with a crystal detector set, which, at the best, is not very strong, so the only way you can make up for this weakness is to use the best possible aerial. A single wire 150 feet long would be the best. You can run several wires in parallel as you suggest, but make them as long as possible and space them two or three feet apart. You can also run the wire around the roof if you wish, but such aerials are not considered very good on account of the water spouts, etc., which run down to the ground, causing a leakage.

J. L. G., St. Louis Mo.

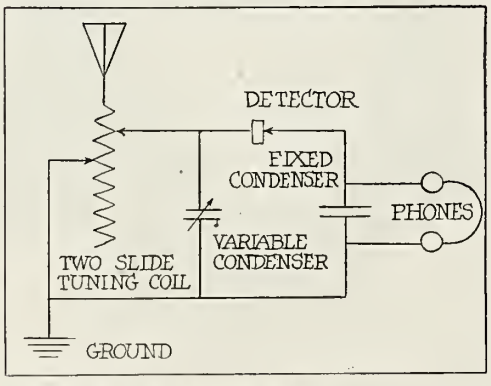
Question: I am now constructing a crystal detector set as described in your May number, and would like a little information. Would a fixed condenser, or a variable condenser, or both, increase the efficiency of this set? If so, how would I wire the condensers to the set? I am just a beginner at this game, and would appreciate any information you can give me as to how to make these condensers and wire them to my set. In Figure 4 of your April number, page 13, in drawing of completed set, it shows two short pieces of wire between your ground and antenna. Should these short pieces be touching, or a gap in between? What purpose does this accomplish?

Answer: Yes. Connect the fixed condenser across the two binding posts, to which the head phones are connected, and connect the variable condenser across the aerial and ground binding posts. It would not pay to make these condensers, as the fixed condenser can be purchased for about 50 cents, and the variable requires too much skill, and too many special tools. The two short pieces of wire which you mention should not touch, but should be spaced about $\frac{1}{16}$ of an inch apart. They act as a safety discharge gap for charges which may accumulate on the aerial during an electrical storm.

W. R. N., Maywood, Ill.

Question: Can my set be improved by using a variable condenser, and how much farther will I be able to receive radio messages if I use one in my set? I am enclosing a diagram showing how I have it connected up. Will you kindly make a sketch telling me how to connect it in my set? Is an antenna 75 feet long with 4 wires all right for this outfit? One end is fastened to a tree. Will this make any difference?

Answer: No doubt the addition of a variable condenser will help your set, but it would be hard to say how much it would increase the range. You will find that on certain nights you can hear much farther than on others. This is due to atmospheric conditions, and you should not blame it on to your receiver. Your aerial is good if it is high enough. It should be at least 35 feet in height. The tree will not interfere with it. Diagram showing the connection for the variable condenser follows:



R. D. M., St. Louis, Mo.

Question: I am contemplating building a radio set described on page 7 of your May issue, but wish to build the tuning coil on a cylinder 2¾ inches in diameter instead of 4 inches. Can I use the same number of turns and taps as on the 4-inch coil? If not, what do you advise?

Answer: Yes, you may use the same number of taps and turns. The only difference will be a slight reduction in the wave length on account of the decreased inductive effect.

V. B., Evanston, Ill.

Question: Please tell me how to hook up a vacuum tube with the terminals marked +, —, G and W. Will a sal ammoniac or battery work on a vacuum tube? If they will, how many will it take?

Answer: I do not understand your first question. The terminals on a vacuum tube should be marked F, F, G and P, in which F means filament, G means grid, and P means plate. If you are speaking of the marking on the panel, it would be necessary for you to send in a drawing of the circuit of your set. The batteries which you mention will not do, as the sal ammoniac cells would polarize in a few minutes, and the current from the gravity battery is not strong enough.

N. E. C., Chicago, Ill.

Question: Where can I buy the parts for making a radio set which will receive messages from all the stations east of here? What kind of a radiophone will be required, and how much will it cost?

Answer: There are numerous radio supply houses in Chicago, and most of them advertise in the magazines and papers. You will need an audion detector set and a two-stage amplifier for this work, and if you are going to construct it yourself, I should judge that it would cost you fifty or sixty dollars. With this outfit you should be able to receive messages from a distance of 1,000 miles or more.

C. B., Chicago, Ill.

Question: What causes the crackling noise in my phones? Some nights I can hear Detroit and Pittsburgh just fine, and then on another night I don't get them at all. I have looked over all the connections and they seem to be all right. Do you think it could be in my batteries? I have changed them once and it did not seem to make any difference. The nearest trolley line is three blocks away; could this make the noice and if so, why don't I hear it all the time, as the cars run day and night?

Answer: Your trouble is no doubt due to static. This is a condition which occurs quite often, and especially so in the summer time. There is no remedy for it that I know of, and if you are sure that all your connections are good and your batteries are all right you can not do anything more.

B. J. E., Janesville, Wis.

Question: The boys of our club are building a radiophone sending station and we would like to know whether or not we will have to get a license for sending before we can use

Questions and Answers

Conducted by FRANK D. PEARNE

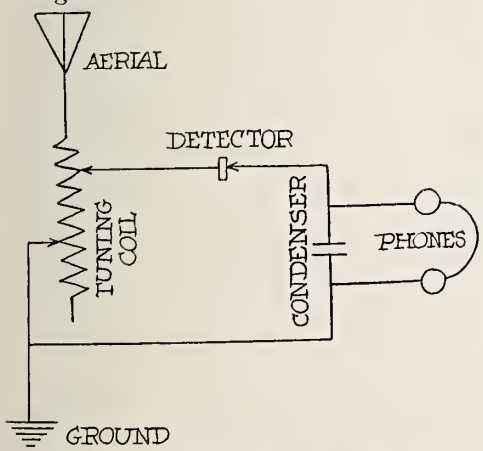
it. We only expect to use one 5-watt tube, but might possibly get another one if necessary.

Answer: You must procure a license from the Government inspector in charge of your district, or you will be in trouble as soon as you begin to use it. This will cost you nothing, but you will have to show that you understand what you are doing before a license will be granted. You will also have to be able to send and receive the required number of words per minute, and keep your wave length down to 200 meters.

W. B. F., Lincoln, Ill.

Question: I have a radio outfit which is made up of a two-slide tuning coil, crystal detector, condenser, and a pair of 2,000 ohm receivers. I have tried to connect them every possible way, but the best I can get out of it is a humming noise. Will you please tell me what is the matter, and draw a picture showing just how it should be hooked up so that I can hear something besides a hum?

Answer: The two diagrams which you enclosed are wrong. Connect the set as shown in the following diagram:



The humming noise which you hear sounds as though you were pretty close to some electric power line. If this is true, change your aerial so that it will be at right angles to this line.

R. J. Z., Fort Wayne, Ind.

Question: If it will not be imposing too much upon your good nature I should like to have you answer a few questions for me, as I am in great trouble. Will an aerial which is 6 feet above the roof attract lightning? My landlord says that it will and insists that I take down my antenna or move out. I understand that it is really a protection, rather than a hazard, but he says the insurance company will raise his insurance unless it is removed.

Answer: Your landlord is mistaken. If you protect your aerial with the proper kind of a lightning arrester and switch, the building is safer than it would be if the aerial were not there. I think the question of insurance is a bluff, because the insurance companies as a rule know that a properly protected aerial is really a safeguard against lightning.

C. C. C., South Bend, Ind.

Question: Does it make any difference which way the battery is hooked up to my audion set. I was told that it made no difference which way it was wired. It seems to work much better when the red wire is connected to the receivers, but when I connect it this way the bulb gets blue inside after I use it a few minutes.

Answer: By all means connect the positive to the plate, otherwise no current will flow through the tube and the receivers. This is probably the red wire which you speak of, as you say it works best this way. The blue appearance of the bulb is caused by too high a voltage on the plate. Try cutting it down and see if this don't stop it.

E. L., Muscatine, Iowa.

Question: My crystal detector set is an Amrad. How far should I be able to hear music with this set? I have never been able to hear KYW at Chicago, although I can hear Davenport quite well at times. Please let me know as soon as possible, as I understand the Chicago music is good.

detector set is about 50 miles.

Answer: The range of a crystal detector set is about 50 miles.

Inside Aerials Safer?

Ben F. Clark, chief electrical inspector for the city of Detroit, is telling radio fans of safeguards against the hazards of lightning and high frequency surges from electrical power lines.

"Outside aerials can not be made absolutely safe," Mr. Clark says. "The utmost precautions known to electrical engineers can only minimize the danger from lightning and high frequency surges.

"The inside loop or aerial can be made absolutely safe, and inside installation is just as effective as outside installation for receiving from all ranges, and with all kinds of equipment.

"The city bureau of electrical inspection urgently recommends inside aerials without exception. Fire insurance companies are joining us in this recommendation. All radio enthusiasts who insist on using outside aerials should arrange for the bureau of electrical inspection to supervise the installation. The city electrical engineers will be glad to do this in every case."

Newspapers and Radio

ONE after another the newspapers of the country are adding a radio department to their news sections. Many of them are producing really comprehensive, instructive material on construction and operation. Almost all of them in the neighborhood of the larger broadcasting stations are publishing the daily programs.

The Chicago Herald and Examiner, which has one of the best radio departments in the country, edited by "Tom" Coates, publishes programs of eight stations in as many widely distant cities. The Herald and Examiner wisely gives the Chicago time of the commencement of these programs, relieving the reader of much trouble in trying to adjust geographical differences and in sorting out those cities that differ in their daylight saving ideas.

The Chicago American also has a useful radio section. The American is a pioneer in this field. The Chicago Daily News not only has a daily radio department, but issues a special radio section on Saturdays. The Daily News has established a radio service to be broadcast through the Fair radio station. Meanwhile it is using the KYW station.

The Detroit Daily News has attracted country-wide attention with its powerful transmitting station and its alert radio news department. The News has a booklet on the press which it will mail free to all who send their names and addresses and ask for a copy.

A radio broadcasting station has been opened in the building of the San Francisco Examiner.

The Kansas City Star has installed a 500-Watt, Western Electric broadcasting station similar to the Detroit News equipment. The new station already has stimulated radio interest in Missouri, Kansas and Nebraska.

Making a Transformer

(*Continued from page 8*)

the hole and begin winding. After 12 turns have been wound punch another hole in the tube and twist the wire into a long loop about 12 inches long, which is threaded down into the tube through the hole and then continue with the winding until another 12 turns are wound, when another hole is punched, and another loop is made and put down into the tube.

This process is continued until 15 coils of 12 turns each have been wound, and the final end of the winding is brought down through the last hole. There should now be 14 loops and 2 single ends of the wire which have been put down into the tube, and the winding on the outside should be perfectly smooth. As these ends and loops begin to bother while winding, they can be temporarily folded back inside of the tube to keep them out of the way. This coil should now be varnished with shellac and allowed to dry.

Making the Switch

The switch should now be constructed. The best way to make this is to purchase the contact points and the switch lever with a hard rubber handle already mounted on it, from some electrical supply dealer. Any store that deals in radio apparatus can supply this, but if it is not convenient to do this make the switch contacts out of 6-32 brass machine screws. These are put through the holes shown in the front view of secondary end "C" Figure 2 and fastened on the other side with a brass nut. The switch lever "L" as shown in Figure 3 is made of spring brass $\frac{1}{32}$ of an inch thick and turnover about $\frac{1}{16}$ inch on the end, so that it will make a good contact on the contacts. An 8-32 brass machine screw holds this in place on the secondary end "C" Figure 2. A brass washer is first placed on the screw, then the switch lever, another washer, and the screw is then put down through the hole in the center of "C" and clamped fast with a nut on the other side. Before this is fastened however, some kind of a knob should be pinned fast to the switch lever as shown in Figure 1. Fasten 2 binding posts with screws through the 2 bottom holes shown on "C" and you are now ready to wire the switch.

All the loops and ends are all brought out of one end of the tube. As the end of the tube from which the wires now project is to be forced over the projection on "C" and glued fast, the connections will have to be made with plenty of slack in the wires, so that they can be pushed back into the tube after they are soldered to the switch contacts. Begin by soldering the wire from the distant end of the coil, to the last contact and the loop next to it, to the next contact etc., until they are all connected, except the last single wire which is connected to one of the binding posts. The screw which holds the switch arm, is then connected to the other binding post. Now push the tube over the projection on "C" and glue it fast.

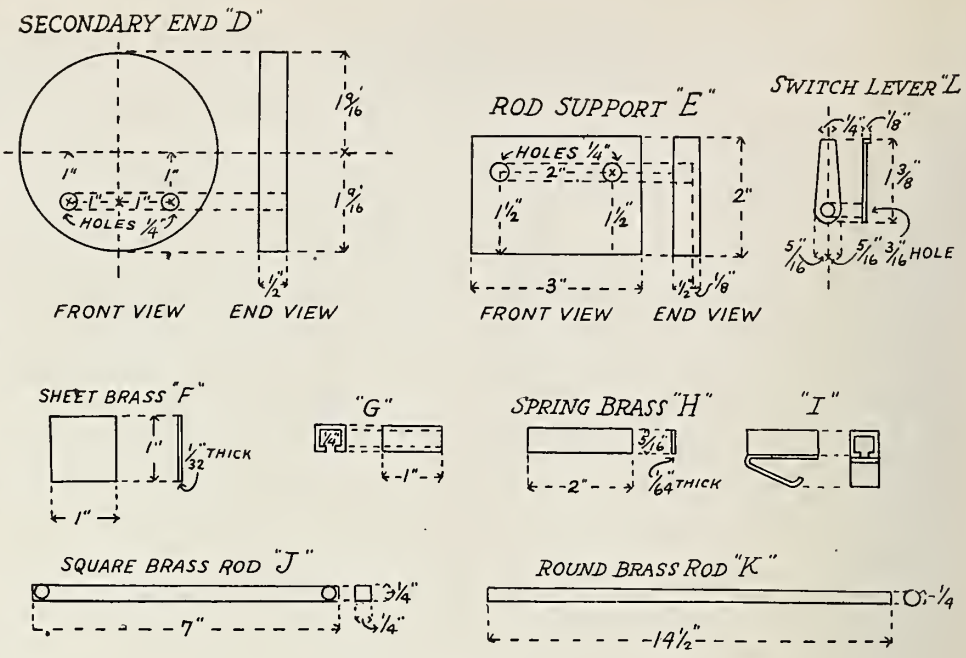


FIGURE 3.

Assembling the Coil

The secondary end "D" Figure 3 is now glued into the other end of the tube, being careful to see that the ¼ inch holes for the supporting rods line up right. Next, the 2 brass supporting rods "K" Figure 3 are put through the holes in both secondary ends, and the coil is assembled and mounted on the base, as shown in Figure 1. One end of the brass supporting rods is held in place by the holes in the primary end "B", and the other by means of the holes in rod support "E" Figure 3. When all the parts are mounted as shown in Figure 1, the secondary should slide in and out of the primary without touching it at any point. Now procure a piece of square brass rod ¼ inch square and 7 inches long and drill a ⅛ inch hole at a distance of $\frac{5}{16}$ of an inch from each end, as shown as "J" Figure 3.

A piece of soft brass 1 inch square and $\frac{1}{32}$ inch thick, "F" Figure 3 is bent so that it will fit around the brass rod, as shown at "G" in Figure 3. A piece of thin spring brass "H" is soldered fast to the bottom of "G" as shown at "I" and is bent into the proper shape to press on the wires of the primary, when placed on the rod and mounted as shown in Figure 1. A hard rubber or wooden knob can be fastened to the slider.

The square brass rod is placed in the slots in the top of the primary ends and fastened with brass wood screws.

Carefully clean off the insulation from the wire on the primary in a straight line under the slider, so that the slider spring will make a good electrical contact with the wires, as it slides back and forth. Connect a wire from the slider rod to one of the binding posts on the base, and connect one end of the primary coil to the other binding post, leaving the other end of the primary coil dead, and not connected to anything.

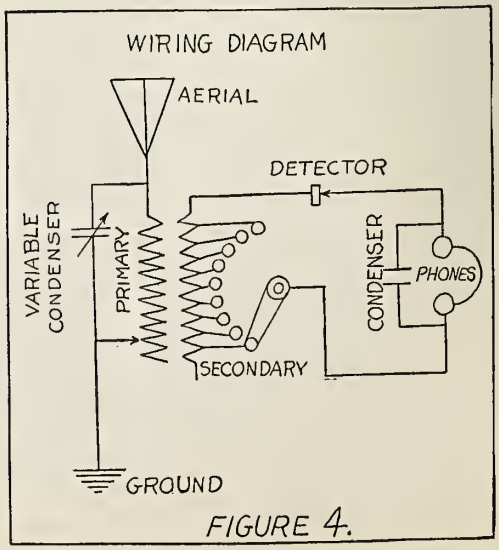


FIGURE 4.

Radio News from Coast to Coast

Readers who have reason to be proud of achievements in Radio in their own localities have a place in this department of Radio Age to tell the rest of the country about it. Contributions will be welcomed.

Arkansas

RADIO fans cannot be classed as nuisances, according to a court decision in Little Rock. It was objected that operators of wireless equipment were making "buzzing noises" between the hours of 9 p. m. and 7 a. m. The court held that wireless inconveniences must be tolerated just as we have to tolerate the blowing of whistles and the rattle of street cars.

Citizens of Pine Bluff are buying a fine receiving outfit for the State's Industrial School for Boys.

California

San Francisco police say they have nipped a system of tapping news of stock market operations. The wireless tappers are said to wear a hidden belt supplied with power sufficient to transmit messages. Even if true, the police fail to explain how any law is violated.

Amateurs' interference prevented the clear receipt of a telephone message sent from the Westinghouse station in Newark, N. J., to the Rockridge station at Oakland. Another test will be made. Newark stations report having heard conversation from San Francisco, but not during official tests.

Church of the Open Door at Los Angeles claims to be the first church to install a transmitting station. It will operate Sunday mornings and evenings and Wednesday evenings.

Mr. and Mrs. Charles Adair of Los Angeles started on an automobile trip to New York April 21. Their car is equipped with a radio phone.

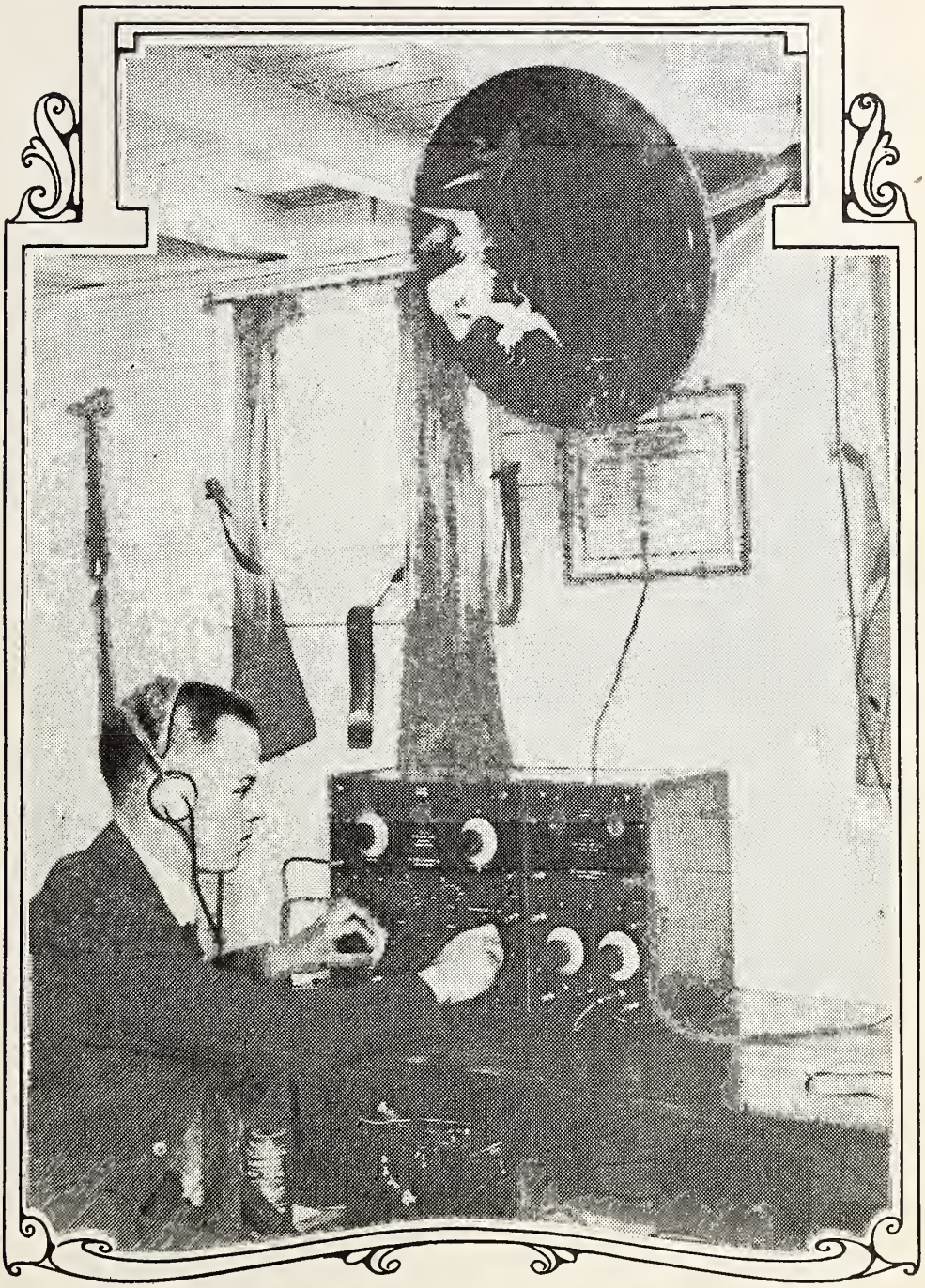
Colorado

The Northeastern Colorado Radio Club has been organized at Sterling. H. T. Van Valkenburgh is president.

Indiana

Radio phone has been purchased by Paul O. Moyer Post, American Legion, at Hartford City. Public concerts and market reports for farmers will be featured.

Mrs. Harriet Steele, 68 years old, listened to songs by her daughter, Miss Floss Steele, transmitted from Chicago to LaPorte while a 55-mile storm was raging.



Alan N. Cormack's motor launch "Spoonbill," of San Francisco, is completely equipped with radio apparatus. When tired of navigating, he listens to concerts and news reports. International News Reel Photo.

Iowa

Davenport's transmitting station is located in the Palmer School. It sends out educational talks between 3:30 and 4 p. m. Concerts are broadcast between 7 and 8 evenings.

The radio phone at the Auto Supply Co. at Estherville has become the most popular thing in that part of Iowa.

The Times-Record Co. of Aledo has installed a radio outfit.

Charles G. Pelton of Waterloo, 21 years old, has been a radio student for seven years. He formerly was in charge of wireless work for the Government in Samoa and at Honolulu. He was the only white resident on one little Pacific island for 17 months.

Davenport Y. M. C. A. will not only install radio equipment but will start a radio school.

Iowa Radio Convention was held in Boone April 28 and 29 under direction of Iowa State College, and attracted visitors from all over the state.

Dyersville has a station that picks up Newark on the east and Denver on the west.

Frank Allen, 117 Marshall street, Boone, sent a message that was heard in Christobal, Panama, 2,500 miles distant.

Kansas

Hutchinson and Wichita are installing radio equipment for police communication

concerning pursuit of escaped criminals and automobile thieves.

It is reported that the American Telegraph and Telephone Co. is contemplating installing a broadcasting station at Hutchinson. The announcement was made by H. J. Bamford, radio specialist, connected with the Hutchinson Grain Radio Club, Inc.

Louisiana

M. M. Mandot, superintendent of the Columbia Light and Power plant at Columbia, is back of a plan to install a transmitting station at Columbia.

Mr. Edward T. Jones, formerly radio supervisor Gulf Division, U. S. Shipping Board, and at one time associate editor Radio News of New York, radio editor, experimental science of Washington, D. C., has resigned from the board to accept a position in the capacity of manager radio department of the Electric Supply Co., 324 Camp street, New Orleans. The Electric Supply Co. has been appointed a RCOA distributor.

The Louisiana Fire Prevention Bureau warns radio users not to ignore fire laws and insurance regulations in installing outfits. It offers to inspect outfits on request.

Massachusetts

Boston experts are interested in devices designed to not only automatically register S O S calls from ships but have such calls accompanied by an alarm device that will attract the attention of any person in or near the station.

It is announced in Boston that the International Radio Corporation will have a string of 100 retail stores in the principal cities of the country.

Hundreds of New England amateurs heard the remarkable tests carried on 1,600 miles between the steamship America and several land stations. The America was equipped with two distinct aerials, one for transmission and one for receiving.

A radio constructor and adviser sued for his pay and when he tried to explain technical radio to a jury in Everett the veniremen asked that he repeat it all. Then they took a recess to rest their brains.

Carl E. Berg, 8 Douglas street, East Lynn, a radio specialist, induced the announcer at the Medford Hillside one night recently and asked that a message be broadcast saying that he was tied up on an installation job and could not be home for dinner. Mrs. Berg was listening in at the psychological moment and got the message. Thirty thousand other homes got Berg's message, but Berg said he didn't care if the whole world listened in. He didn't want his wife to worry. And there you are.

The Massachusetts State Police Patrol has instituted a radio phone service. A transmitting station will be installed at Framingham as the first unit in the system.

Michigan

Detroit reports that radio youths have stolen large numbers of telephone sets from apartment and office buildings.

The "Schoolhouse on Beech Road" at Moore put on a district school radio show. The entertainment was followed by a chicken dinner. That beats the old time spelling bee.

Henry Ford is to jazz things up in his plants by introducing radio stuff. He is licensed to install transmitting equipment.

Congressman Vincent M. Brennan of Michigan introduced a bill providing for the installation of a transmitting station on the floor of the house. Thereby hoping to scoop the congressional record, perhaps.

The Marinette Electrical corporation has begun to manufacture radio equipment. Fifty persons will be employed.

So many residents of Alpena attended the Detroit Radio Show that the Alpena Radio club called off its weekly meeting.

Battle Creek has a growing radio club.

Governor Grosbeck spoke from the Detroit News transmitting station calling attention of radio phone listeners all over the state to the advantages of living and working in Michigan.

Nebraska

T. J. Bolger, of Chadron, has been listening in on Denver and Toledo. Valentine, Alliance, Rushville, Harrison and Hot Springs are receiving messages from all over the country.

A Norfolk operator heard a Western Union radio message recently and telephoned it to the person for whom it was intended. He beat the Western Union delivery.

New Jersey

An Elizabeth boy, with an umbrella as an aerial and a screwdriver thrust into the ground as a ground connection, hears messages with an outfit about the size of a loaf of sugar. He has been studying radio 10 years.

Thus far the New York Signal Corps station has been unable to pick up the United States Army Signal Corps' new

Mrs. William Randolph Hurst addressed many thousands in the interest of the Free Milk Fund for Babies. Her talk was transmitted by WJZ station at Newark.

New York

The American Telephone and Telegraph Co. will build a broadcasting station on the roof of its 24-story building in New York City. Steel towers, supporting the antennae will be 100 feet high.

New York's east side has seized upon radio as a diversion and as many of the instruments have amplifiers the result in that congested district is something like Bedlam at times.

The fourth annual aviators' ball featured dancing by radio. It was held at the Astor Hotel.

station at the Presidio Reservation, San Francisco. The Pacific coast station is one of the most powerful in the service.

Ohio

Disabled former service men are to be entertained by radio at Cincinnati's Altamont hospital. Women of a ladies' auxiliary are raising the funds to install equipment.

East Liverpool has imposed a fee of $2 to be paid by all owners of radio outfits in that city. It is an annual tax. The revenue is to be expended for inspection by the fire bureau.

Sandusky believes that a mineral deposit is preventing that city from hearing Chicago. Broadcasters in Chicago have been trying to solve the mystery.

Pennsylvania

The Pennsylvania Federation of Music Clubs in session at the Wanamaker Store in Philadelphia declared radio represents one of the best means of disseminating good music.

South Dakota

When Elk Point was cut off from telegraphic and telephone communication with the outside world by a storm recently radio was resorted to. Sioux Falls established radio communication with Elk Point and directed the work of repairing wrecked buildings, tangled wires and broken poles. Supplies were ordered from Sioux Falls by wireless.

Tennessee

The Knoxville Radio Co. of Knoxville is the first Tennessee concern to receive a charter exclusively for the manufacture of radio apparatus. It is incorporated at $50,000.

Texas

Mrs. O. R. Garrett is the first woman in Texas to hold a first grade amateur radio license. She is also a first-class land line operator. Her husband is president of the Fort Worth Radio Club.

A radio auditorium that will seat several hundred persons is announced for the White House, an El Paso establishment.

Clarence Wortham, an outdoor showman, is taking radio phones with him on this season's itinerary. He starts from Dallas.

Texas farmers in the vicinity of Lancaster are to receive weather bulletins through a new receiving station to be established for the purpose. Several farmers have their own sets in their homes.

A radio shop has been opened at Amarillo by Raymond A. Pittman.

Denison has organized a radio club. There will be facilities for public entertainment.

Five candidates for commercial radio licenses were recently examined in Dallas.

Two radio receiving sets for concert purposes have been installed by the Adolphus hotel at Dallas.

West Virginia

The Wheeling Baptist Temple held a special radio survice, receiving the complete Sunday program of a Pittsburgh station.

Wisconsin

All Wisconsin is awaiting the Milwaukee Radio Show, June 21 to 25, inclusive.

The Milwaukee Real Estate Board expects to get radio reports of the national convention of realtors in San Francisco in June. Milwaukee considers it possible that radio may supplant conventions altogether in the future.

Instructive ten-minute features are included in programs outlined for the University of Wisconsin broadcasting stations.

Fire stations everywhere take to radio. Oshkosh firemen have their own receiving apparatus. It beats rhummy and old jokes on dull days.

Fond du Lac boys are buying all obtainable radio supplies. Their interest has been stimulated by the broadcasting service at Madison.

Wyoming

Radio outfits will be installed in out of the way spots in Wyoming for the dissemination of religious appeals. Bishop Nathaniel S. Thomas, Episcopal missionary bishop of Wyoming, is promoting the plan. He says mission stations are few and far between in his state and the church finds it impossible to reach some of the people oftener than once a month. Hence the radio plan.

How the Government Will Control Radio

(*Continued from page* 4)

"BROADCASTING" signifies transmission intended for an unlimited number of receiving stations without charge at the receiving end. It includes:

(1) **Government broadcasting** signifying broadcasting by departments of the Federal Government;

(2) **Public broadcasting** signifying broadcasting by public institutions, including state governments, political subdivisions thereof, and universities and such others as may be licensed for the purpose of disseminating informational and educational service;

(3) **Private broadcasting** signifying broadcasting without charge, by the owner of a station, as a communication company, a store, a newspaper, or such other private news, entertainment and other service; and

(4) **Toll broadcasting** signifying broadcasting where a charge is made for the use of the transmitting station.

Note 2. A station carrying on two or more of the broadcasting services specified in classes 2, 3, and 4 must be licensed for each class of service.

Note 3. When transoceanic radio telephone experiments are to be conducted the Department of Commerce should endeavor to arrange with other countries for the use of the wave band 5,000 to 6,000 meters assigned for this purpose.

Note 4. The wave band from 2,850 to 3,300 meters may be used for fixed service radio telephony only provided it does not interfere with service using continuous wave telegraphy.

Note 5. The wave band from 1,550 to 1,650 meters is for use of radio telephone communication over natural barriers, but is not exclusive of other services.

The Marine Service

Note 6. Radio beacons are radio transmitting stations which transmit signals from which a mobile direction finding station may determine its bearing or position.

Note 7. Radio compass service is here used to signify a direction finding service in which a mobile station transmits to one or more fixed stations which in turn transmit back the bearing or position of the mobile station.

Note 8. The wave band from 525 to 650 meters is reserved for marine radio telegraphy, exclusive.

Note 9. Assignment of waves in band 16 will, in general, involve keeping the zones from 285 to 315 and from 425 to 475 meters open in coastal regions. Furthermore, in border regions, account should be taken of the wave lengths used in neighboring countries, and these should be suitably protected by a locally unused band of adjacent wave lengths.

Note 10. The restricted special amateur wave of 310 meters is for use by a limited number of inland stations and only where it is necessary to bridge large, sparsely populated areas or to overcome natural barriers.

Note 11. City and state public safety broadcasting should in small cities be conducted by interrupting the broadcast service of classes 2, 3, or 4 in case of emergency. In large cities this service will ordinarily have its own stations and will use the wave band, 275 to 285 meters, assigned to such service. Private detective agencies desiring to operate radio telephone broadcasting service should be required to co-operate with municipal or state services in the use of the wave band 275 to 285 meters, assigned to the latter service.

Note 12. By "technical and training school" in this report, is meant a school which in the judgment of the Secretary of Commerce is carrying on sufficient instruction of the proper character for training men for the radio profession to warrant the granting of a station license for that purpose.

Note 13. An amateur is one who operates a radio station, transmitting, receiving, or both, without pay or commercial gain, merely for personal interest or in connection with an organization of like interest.

Note 14. The Conference is of the opinion that broadcast transmitting stations should not in coastal regions be permitted on wave lengths closely adjacent to those assigned in the marine traffic and believe that its recommendations provide for adequate protection of such marine traffic. The Conference recommends the assignment of wave lengths adjacent to those used in the marine traffic to inland stations under such conditions as to avoid interference with the marine traffic.

Harry Levison, Cincinnati, made a receiving set in a watch

B. It is recommended that the Secretary of Commerce assign a specific wave length to each radio telephone broadcasting station (except Government and amateur stations), this of course being within the band pertaining to the particular service of that station.

C. It is recommended that the wave band assigned to amateurs, 150 to 275 meters, be divided into bands according to the method of transmission, damped wave stations being assigned the band of lowest wave lengths, interrupted or modulated continuous wave radio telegraph stations the next band, radio telephone stations the next band, and finally unmodulated continuous wave radio telegraph stations the band of highest wave lengths. It is recommended that amateurs be permitted to carry on broadcasting within the wave length band assigned by the Secretary of Commerce to amateur radio telephony.

Some Definitions

A damped wave is one composed of successive trains in which the amplitude of the oscillation after having reached its maximum decreases gradually. This refers to waves from spark transmitters or other types of transmitters having characteristic decrement similar to spark transmitters. Transmitters employing continuous wave oscillators in which the variation in frequency or amplitude is abrupt, (as with the use of a chopper), are classed as damped wave transmitters.

An interrupted or modulated continuous wave is one in which the amplitude or the frequency is varied according to a simple periodic law of audible frequency. (This is commonly referred to as the interrupted continuous waves, or I. C. W.) A continuous wave transmitter employing a rectified plate voltage which is not a substantially constant direct voltage is classed as an interrupted or modulated continuous wave transmitter. Note: This included transmitters in which the variation in amplitude or frequency is effected in a gradual way only. (For abrupt variation see damped wave.)

An unmodulated continuous wave is one in which the permanent state is periodic and has substantially constant amplitude and frequency. (This includes waves in which the amplitude variation is effected simply by the manipulation of a key. This is commonly referred to as a continuous wave, or C. W.)

D. It is recommended that the present regulations governing experimental station remain in effect. An experimental station is one operated exclusively for technical or scientific investigations.

E. 1. The Conference experienced the greatest difficulty in providing even partly for the generally demanded services. The Conference therefore disapproved of the elimination of essential services by the introduction of direct advertising which might be expected to require extensive assignment of wave bands if permitted at all.

2. Many services for which radio telephony might otherwise be desirable can not practically be conducted by this means on account of the interference which such use would cause with other services of a more essential nature or for which there is great public demand.

3. In view of the demand for broadcast service by the general public, it is not desirable to disseminate information over wide areas for purposes of point-to-point communication except where that communication cannot be effectively maintained by other means.

The "Multiple Telegram"

4. A radio service in which a message is addressed or intended for a prescribed number of particular stations is not a broadcast service and is to be classed as a "multiple telegram" or "multiple telephone service." It was not thought advisable to use the much demanded short wave bands for communications of this nature as they would serve a relatively small number. The available wave lengths for such multiple service messages are bands 2 and 5.

5. The Conference is of the opinion that the use of radio communication for "point-to-point" communication over land in most cases constitutes an uneconomic

use of the available wave bands and it is recommended that at the present state of the art such communication should be carried on by other means, in so far as possible.

6. The Conference very carefully considered the proximity of wave bands assigned to amateurs and broadcast services but deemed it essential to utilize all of the available wave bands.

7. It was felt that waves longer than 275 meters should not be assigned to technical and training school stations because of the needs of broadcast services greatly desired by a large portion of the public in that zone, and because the extension of amateur wave lengths and the organization of their use will enable their effective employment by the technical and training school stations.
vschooek b

II. Power Distribution and Hours

A. It is recommended that the Secretary of Commerce assign to each radio telephone broadcasting station a permissible power based on the normal range of the station, such normal ranges for the different classes of service to have the following average values, larger or smaller values being discretionary where conditions warrant.

Government broadcasting stations, 600 (land) miles.

Public broadcasting stations, 250 miles.

Private and toll broadcasting stations, 50 miles.

Normal range is the average reliable daytime ranges over which satisfactory communication can be obtained with good available receiving apparatus.

Rule Is Elastic

The Conference recommends that broadcasting stations should not be allowed to use unlimited power because of the fact that this will limit the number of services which can be rendered within a given area to an undesirable extent.

(NOTE: The Bureau of Standards of the Department of Commerce should make a study of the relation between the normal reliable range of a station and the antenna power on the basis of the use of good available receiving apparatus. It is recognized that this relation may change with the development of the radio art.)

B. It is recommended that the same wave (or overlapping wave bands) not be assigned to stations within the following distances from one another, except that these distances may be lowered if the normal ranges of the stations are correspondingly lowered.

For Government broadcasting stations, 1,500 miles.

For public broadcasting stations, 750 miles.

For private and toll broadcasting stations, 150 miles.

(NOTE: The Bureau of Standards should make a study of the width of wave band (expressed in cycles per second) required for satisfactory radio telephony. It is recognized that this width depends on the methods of transmission and reception employed.)

C. It is recommended that the Secretary of Commerce cause an immediate study to be made of the best geographical distribution of broadcasting stations with the view of attaining the best service with a minimum of interference.

D. It is recommended that in cases where congestion of radio telephone broadcasting traffic exists, or threatens to exist, the Secretary of Commerce assign suitable hours of operation to existing or proposed radio telephone broadcasting stations.

III. Granting Licenses

A. It is recommended that in the case of conflict between radio communication services first consideration be given to the public not reached, or not so readily reached, by other communication services.

B. It is recommended that subject to public interest and to the reasonable requirements of each type of service the order of priority of the services be Government, Public, Private, Toll.

C. It is recommended that the degree of public interest attaching to a private or toll broadcasting service be considered in determining its priority in the granting of licenses, in the assignment of wave frequencies, and in the assignment of permissible power and operating time, within the general regulations for these classes of service.

D. It is recommended that toll broadcasting service be permitted to develop naturally under close observation, with the understanding that its character, quality and value to the public will be considered in determining its privileges under future regulations.

E. It is recommended that direct advertising in radio broadcasting service be absolutely prohibited and that indirect advertising be limited to a statement of the call letters of the station and of the name of the concern responsible for the matter broadcasted, subject to such regulations as the Secretary of Commerce may impose..

F. It is recommended that when all available wave frequencies in any geographical region are already assigned, no further licenses for broadcasting be granted in that region until cause arises for the revocation of existing licenses.

G. It is recommended that private or toll broadcasting stations transmitting time signals shall transmit only official time signals and with authorization from and under conditions approved by the Secretary of Commerce.

H. It is recommended that the transmission of signals of such character or wave length as to deliberately interfere with the reception of official time signals constitutes grounds for the revocation or suspension of the transmitting station or operator's license.

I. It is recommended that license requirements for the operator of a radio telephone transmitting station include a knowledge of radio transmitting and receiving apparatus and of the International Morse Code, sufficient to receive at a rate of not less than 10 words per minute.

J. It is recommended that the establishment at any later date of any commercial transmitting stations having more than 1 k.w. input to the antenna may, at the discretion of the Secretary of Commerce, be prohibited within 25 land miles of a Government or commercial station or in regions where congestion of radio traffic shall warrant such prohibition.

K. It is recommended that the sharpness of the emitted wave of the transmitting station affect the privileges extended to such station.

IV. The Amateur

A. It is recommended that the status of the amateur be established by law and that the limits of the wave band allotted to the amateur as given above in section I be specified in the law.

B. It is recommended that the amateur continue to be under the jurisdiction of the Department of Commerce.

C. It is recommended that for the purposes of self-policing among the amateurs, amateur Deputy Radio Inspectors be created, elected from their number of the amateurs of each locality; that upon receipt of notice of such election the Radio Inspector in charge of the district in which such amateurs are located shall appoint the person chosen a Deputy Radio Inspector, serving without compensation or for the sum of one dollar per year if compensation is legally required; that the duty of such amateur Deputy Inspector shall be to endeavor to the best of his ability to accomplish, under the direction of the District Radio Inspector, observance of the Radio Communication Laws and the Regulations of the United States and the observance of such local cooperative measures as are agreed to in each community for the minimization of interference between the various groups of the public interested in radio; that such Amateur Deputy Inspectors be clothed with whatever authority may be necessary in the opinion of the District Radio Inspector.

V. Reduction of Interference

A. It is recommended that the Secretary of Commerce at his discretion prohibit at any time the use of existing radio transmitting apparatus and methods which result in unnecessary interference, provided that such action should not be taken unless more satisfactory apparatus and methods are commercially available at reasonable prices and until an adequate time interval is allowed for the substitution of the more satisfactory apparatus.

B. It is recommended that the Secretary of Commerce at his discretion prohibit at any time the use of existing radio receiving apparatus which cause the radiation of energy, provided that such action should not be taken unless more satisfactory apparatus and methods are commercially available at reasonable prices and until an adequate time arrival is allowed for the substitution of the more satisfactory apparatus.

Note: "Certain forms of oscillating receivers cause the feeble radiation of continuous waves and may therefore be a source of local interference."

C. It is recommended that the Bureau of Standards make a study of the technical methods for the reduction of interference, with a view to publishing their findings, giving special attention to the following:

(1) The reduction of the rate of building up (increment) of oscillations in radiating systems. (This rapid building up of oscillations occurs in damped wave and interrupted continuous-wave transmitters, and may, of course, be eliminated by the substitution of other types of transmitters. It may, however, be reduced in these types by proper circuit arrangements.)

(2) The reduction of harmonies in continuous wave transmitters and of irregularities of oscillation. ("Mush" in arc transmitters and "swinging" of the frequency in some continuous wave transmitters not employing a master oscillator.) "Mush" signifies small sudden irregularities occurring in the antenna current of arc transmitters. Swinging signifies relatively slow changes in the frequency of a transmitted wave.

A harmonic of a wave is a wave whose frequency is a multiple of that of the given wave. (The wave length of a harmonic is thus a sub-multiple of the wave length of the given wave.) It is often convenient to include as harmonics frequencies which are dependent on the frequency of the transmitter but which are not exact multiples.

(3) The comparison of the variable amplitude method with the variable fre-

quency method of continuous wave telegraphy.

(4) The preferable methods of telephone modulation to avoid changes in the frequency of oscillation.

(5) The proper circuit arrangements of regenerative (including oscillating) receivers to avoid radiation of energy (as by the use of a radio-frequency amplifier with an untuned antenna or with a coil aerial).

(6) The use of highly selective receiving apparatus, including a list of approved forms. Note: A selective receiver is one which enables the user to hear a desired signal and to exclude the undesired signals. The more perfectly this is accomplished, the more highly selective is the receiver.

(7) The use of receiving coil aerials instead of antennae, with special reference to high selectivity.

(8) The reduction of interference with radio communication of other electrical processes, such as the operation of x-ray apparatus and electrical precipitation.

(9) The study and standardization of wavemeters. Note: A wavemeter is an instrument for measuring wave frequency or wave length.

At a subsequent meeting of the full conference called by Secretary Hoover on April 17, 18, and 19, 1922, it was agreed to add to Section 1 C the provision that the operation of Government stations be conducted in such a manner as not to interfere with the commercial traffic and broadcasting, and that whenever Government-owned stations are used for the transmission of commercial traffic and broadcasting, they shall conform to the regulations established by the Secretary of Commerce.

It was agreed to add a provision for the appointment by the President of an Advisory Committee to the Secretary of Commerce to consist of not more than twelve members, half of whom shall be from the Government and half from outside the Government.

Exhibition Features

In an auditorium opening off the west end of the exposition hall at the Detroit Show, the Detroit News, by moving pictures, stereopticon slides and lectures, revealed, in fascinating detail, the operation of the broadcasting station WWJ, one of the most powerful in America and the pioneer of all newspaper broadcasting stations.

A feature of the Detroit Show entertainment was the operation, by the Lyradion Sales & Engineering Co., of a receiving set seven feet high and four feet wide, designed for concert work in large halls.

Polishing Panels

If you desire to dress the surface of bakelite or formica to prevent finger marks from showing and to give your job a better appearance, sandpaper the surface, using first a medium paper and then a fine grade. Make all strokes the full length of the panel. Finish by polishing with a cloth moistened with linseed oil.

Students and instructors at work in the radio department of Lane Technical High School. These students have built many instruments which will be exhibited at the Pageant of Progress in July

High School Radio

(*Continued from page* 11)

convenient switch, which runs over taps taken from the vario-coupler, increases or decreases the wave length of the set. The amplifier unit is enclosed in another cabinet and can be placed on top or alongside the regenerator. It consists of two stages of audio-frequency amplification which when operated in conjunction with the detector in the regenerator gives the set a receiving range of over 1,200 miles. Not so bad for the boys, eh?

Possibly you will ask the question, "of what educational value is this to the young man of today?" The answer could not be simpler. When a boy builds his own outfit he must know something about it. The result is that he studies the subject and in this way gets the theory while at school he has also the practical experience. When he gets out into the world he will find that what he has learned at school will provide a life vocation for him if he is so minded to follow it up.

There is another branch of the radio department worthy of mention. The code class is a group of young men who meet at certain periods each day to practice the code and also the theory of the radio. All of these students are practicing the code and about half of them have obtained operator licenses from the government. The other half are struggling hard and will have their licenses before the end of the season or know the reason why.

The two men responsible for the radio department at Lane are Mr. A. G. Bauersfeld, Supervisor of Technical Education in the Chicago high schools, and Mr. William J. Bogan, Principal of the Lane Technical High School. Both of these men are ardent radio enthusiasts and have given the necessary impetus to carry Lane to the front in this field.

Universal Amplifier

Secretary Denby announces that the Bureau of Engineering of the Navy Department has finally arrived at a successful design of a universal amplifier for radio communication.

The multiplying qualities of the three electrode vacuum tubes have been known for a considerable time, but the amplification was only possible over a limited band of wave lengths. For use in the navy, apparatus must be serviceable over a wide range and equally efficient over several variations of wave lengths.

As a result of the research work of Dr. J. M. Miller of the Navy's Radio Research Laboratory in Washington, a six stage amplifier has been constructed. The range of this amplifier is from a few hundred to 2,000 meters.

In a Lighter Current

Little Joe had completed his crystal receiving set and had made it "work." His astonished and proud mother said to him, "Wasn't it very hard to do all this?"

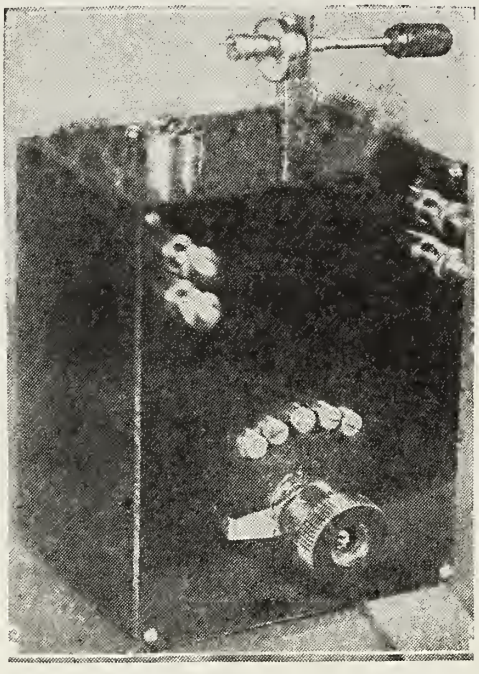
"Naw," said Joe; "most of it was easy as anything."

"What was the hardest part of it?" she asked.

"Gettin' eight plunks out of pa," said Joe.

Here's a
Compact Radio Receiving Set
FREE to Our Readers

This instrument will enable you to hear all concerts, baseball, market and other news reports from 15 to 25 miles from any broadcasting station in your own home. It is equal to any $15 device and it is fully guaranteed. No mechanical knowledge is necessary to install or operate. Full instructions are included with each set.



You can get this wonderful Radio Receiving Set FREE

if you are willing to devote a little effort in telling your friends about RADIO AGE. It's as simple as A. B. C. Just write your name and address on the coupon below and we'll send you full particulars by first mail out. Let 'er go!

RADIO AGE, *Circulation Department* Date .....
64 West Randolph Street, Chicago

I am interested in securing one of your Radio receiving sets which you offer FREE. Please send me full particulars by return mail.

Name .....

Street .....

City ..... State .....

Wireless Weather

Weather forecasts are broadcast twice daily 1,000 miles in every direction by the Great Lakes Naval Radio station, co-operating with the local United States weather bureau office, under the direction of H. J. Cox, meteorologist.

E. B. Calvert, chief of the forecasting division of the United States weather bureau, is aiding in perfecting arrangements for broadcasting weather reports for aviation and marine interests. In addition to forecasting for the states west of Illinois and Wisconsin to Wyoming and Montana, and south including Kansas and Missouri, the Chicago office will forecast the weather and issue storm warnings for all the Great Lakes and Michigan and Indiana.

This enlarging of activities of the local office will be cared for with the present staff, Mr. Cox and his assistant forecaster, E. H. Haines, taking turns alternate months in forecasting.

Arrangements are also being made to send out forecasts for the neighboring states and Lake Michigan by the radiophone operated by the Westinghouse company in the Edison building.

"We hope to install a powerful radio sending station in the Federal building," said Mr. Cox, "but for the present we will send our reports to the Great Lakes Naval Radio station via the Municipal pier radio, where they will be broadcast at 11 o'clock in the morning and 10:30 o'clock each night, to aviation forecast zones number four (including the Great Lakes, Michigan and Wisconsin), eight (including Iowa, Indiana, Illinois, Missouri, Kansas and Nebraska), seven (including Minnesota, North and South Dakota), and ten (including Wyoming and Montana).

"For the special benefit of aviators and shipmasters, bulletins based on the reports from twenty-eight regular weather bureau stations in this country and Canada, and reports from seven aerological stations, together with a general weather synopsis and wind and weather forecasts, will be broadcast twice daily."

ARTISTIC VARIOMETER PARTS

Manufacturers of Variometer Parts in

GENUINE MAHOGANY

We are selling these parts in complete sets—each set consisting of 4 Stators, 2 Rotors and 1 Variocoupler. Prices on the above in 100 sets or more, also on separate parts, will be sent upon request.

Artistic Wood Turning Works
517 No. Halsted St., Chicago, Illinois

"Fading" Explained

Radio fans are advised to spend the coming summer at the seashore if they would obtain the best results. And even there the radio wave sometimes will refuse to work, just like a prima donna. "Fading" is to blame.

Down by the sea this phenomenon is not as disturbing as it is inland. But, any place, "fading" is most apparent at night. The Bureau of Standards recently completed an investigation of "fading," and describes it as "the rapid variation of intensity of the signals received from a given transmitting station."

Every radio fan has experienced the nuisance. At first he thought his set as simple to operate as a phonograph, until he tried to listen-in on his favorite pastor, and failed. Then he realized that the radiophone is as finicky as a limousine. But the set was all right. The fan simply did not known that "fading" may be violently apparent to some receiving stations and not so apparent to others at the same time, all depending upon the distance over which the radio signal must travel, the time of day and a few other highly scientific things.

Three kinds of "fading" are common, according to Dellinger and Whittemore, the bureau experts who conducted the investigation: 1. Fading, or swinging, lasting one second or less. 2. One minute; and 3, in spells of one hour.

The cause of "fading" is hardly known. Experts do know that the troubles lies between the earth's surface and the "heaviside surface"—the roof of the earth's atmosphere about six miles in the air. But the trouble is caused by something that exists either below the ground or above the earth's atmosphere.

During the day, radio waves have a habit of traveling close to the ground. During the night, especially at great distances, they travel along the "heaviside surface"—six miles in the air. But these two extremes do not remove the nuisance of "fading." Day waves are absorbed by the earth and therefore fade in spells of a second, a minute or an hour. Night waves are absorbed by varying conditions in the uppermost level of the atmosphere, and this is even worse.

Commercial radio stations are not bothered with fading to the same degree as the amateur. Most amateurs do their receiving at night, when fading is at its worst. But, it is pointed out, the commercial radio man now finds himself obliged to investigate this disturbance because it is interfering with the success of his broadcasting. And broadcasting is the attractive feature of radio, the feature largely responsible for the sets in 1,000,000 American homes.

Nations Discuss Radio

RADIO has reached the stage of international conferences. Representatives of the United States have been meeting with delegates of England, France and Germany in an attempt to standardize world-wide traffic in wireless communication. The conference has temporarily adjourned, but the conferees, who represent the Radio Corporation of America, the British Marconi Company, Telefunken Company of Germany and Radio-France of France, will meet in another session in London about the 24th of this month.

The sessions of the last meeting, which lasted for five days, and was held in Paris, were secret. It is understood, however, that the discussion turned chiefly about the matter of regulating the wave lengths to be used by different countries in international communication, in order to avoid interference. Other matters discussed were the advisability of licensing American as well as European radio operators, methods of lowering the cost of radio apparatus sufficiently to make it possible to bring it within the reach of every home.

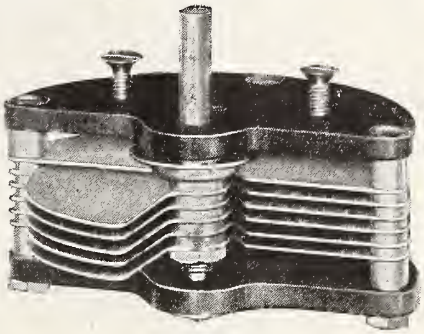
Another conference of experts will meet in Berlin in June, it is said, to present complete findings of a group of engineers who have been studying conditions in South America with a mind to the standardization of technical apparatus, the conservation of wave channels, and point control of stations by the four principal countries of the world. A preliminary report of the findings of these experts was made at the Paris conference, and it is expected that the final version will be ready for presentation by June.

Edward J. Nally, president of the Radio Corporation of America, declined to disclose the results of the conference, but admitted that Germany, France and England were sending experts to the United States to study distribution methods here.

For the Beginner

The most practical and clearest article on how to make a simple receiving set is the one issued by the Bureau of Standards and published in Radio Age last month. Back copies available for those who missed it. Send 25 cents in stamps to Radio Age, Garrick Building, Chicago.

Variable Condensers



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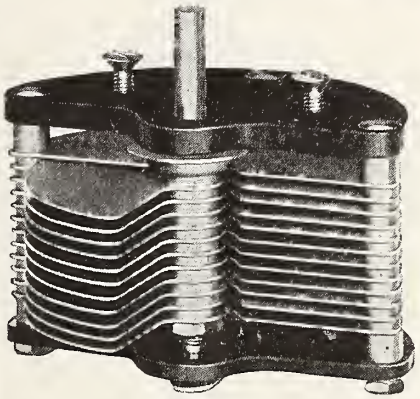
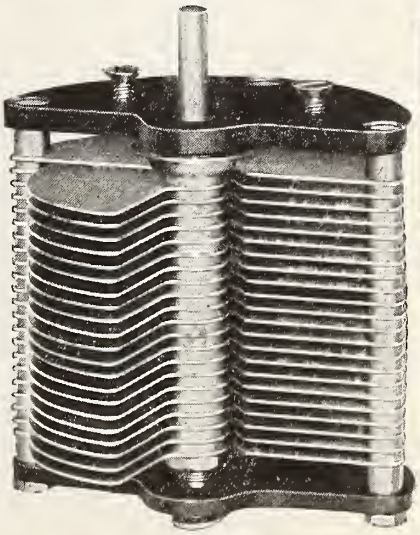


23 PLATE



43 PLATE

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RADIO AGE
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How to Make a Home Radio Set

To cost from $6.00 to $20.00. Contains complete instructions for the construction of a practical home receiving station at small cost.

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CANADA

Fire Escape Aerial

A reader of the New York Globe has found a way to fool the landlord. He writes:

One point I would like to bring out here—for the benefit of your many readers—a point that will interest most every radio enthusiast who resides in an apartment house and has been unable to erect an aerial for receiving purposes, and that is that the average fire escape makes an excellent aerial for receiving purposes when a regenerative set is used. Dandy results were obtained with a crystal.

I have tried out my set on two different fire escapes here in the upper part of the Bronx and received the broadcasting splendidly in each case.

Just clean a portion of one of the bars on the fire escape and attach the aerial wire—make the ground on the radiator or cold-water pipe.

I read a few days ago where a fellow wanted to sell, at a loss, a good regenerative set because his landlord would not permit him to erect an aerial.

Why worry about the landlord, fellows? Get busy with the fire escape, and when you are through using it at night just unhook the aerial wire and take it into the house.

Why Laws Are Needed

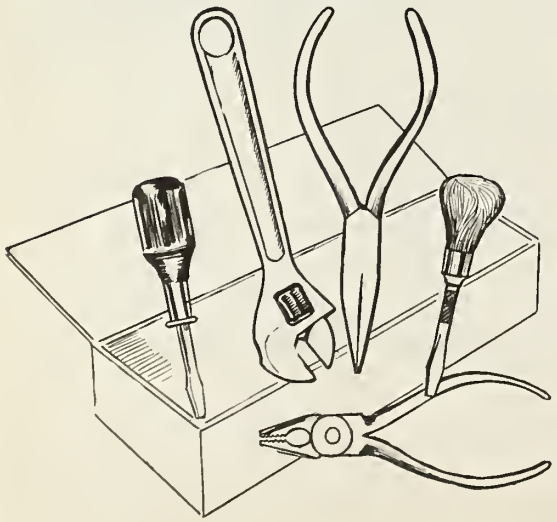
Interference with unscheduled radio transmission while the regular broadcasting programs are being sent out, seriously interferes—not with the broadcasting station—but with the radio public, the receivers. Here is a typical complaint, received by Municipal station WBU from S. Anderson, 2329 Kimball avenue: "I appreciate very much the broadcasting of lectures by station WBU, but I must tell you that some nights I cannot understand one word of the lecture due to interference by other stations. While I am writing this card I am trying to get what the doctor is saying, but right now I hear two stations. Since I am unable to read the code I cannot report who they are, but the only remedy I have to suggest is to change your wave length. It is now ten minutes after 9 and the only part of your broadcasting I have heard was the station announcement."

Government Publications

The Superintendent of Documents, Government Printing Office, Washington, D. C., issues three pamphlets of especial interest to the new station owner—(a) "Amateur Radio Stations of the United States," complete listings of all licensed amateur stations, giving owners' names, addresses and call letters. (b) "Commercial and Government Radio Stations of the United States," complete listing of American ship, shore and land stations. (c) "Radio Communication Laws of the United States," explains how radio stations may be licensed, and gives other information. Pamphlets are 15c each (remit currency, not stamps), and are mailed postpaid. For those interested in the technical side of radio, the Government issues "The Principles Underlying Radio Communications," 55c currency.

you can't build a watch with a monkey wrench

To build a good radio set you need the right tools



A radiophone, like a watch, is a delicate instrument, which might easily be ruined with clumsy, unadaptable tools.

The Radio Tool Kit is a selection of necessary instruments, chosen by a well-known radio authority as essential in the construction of any radio equipment. Every tool in the kit is guaranteed to be of the finest workmanship and of carefully selected materials.

It is composed of a pair of long nose plyers, for delicate construction work; a pair of blunt nosed plyers and wire cutters, for wiring purposes; a radio wrench of highest quality, yet small enough for use in practically any place it might be required; one large screw driver, heavy enough for any work required, and one small screw driver for brass screws.

The set will be mailed for $3.50 to any place in the United States. Either send a post office money order with your order, or fill out the following coupon and it will be mailed, C. O. D., parcel post.

Radio Tool Kit Co.
411 South Sangamon St., Chicago, Ill.

Please send me, C. O. D., the Radio Tool Kit, as represented in this advertisement, for which I agree to pay $3.50 on delivery.

Name.....

Address.....
(RA)

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The Annual

National Radio Exposition

To Be Held in the

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Such Rapid Strides Have Been Made in the Perfection of Wireless Devices That Every Exhibit in the Big Exposition Building Will Display Something New and Interesting to the Radio Fans.

For Further Particulars Address

NATIONAL RADIO EXPOSITION

417 South Dearborn Street, Chicago, Illinois

Lighthouse Concerts

RADIOPHONE concerts for the lighthouse keeper—holder of the world's solitary confinement record —are seen by government officials as the latest possibility of the new art in conjunction with radio fog signal stations now in course of construction.

Already several lightships have turned their wireless telegraph outfits to good use through the long evenings, and enthusiastic reports have reached Lighthouse Commissioner Putnam from lightship captains who listen-in regularly on concerts from Pittsburgh from their anchorage off the Middle Atlantic Coast.

As yet, probably not more than a score of the 16,000 lighthouse keepers have installed radio receiving sets, but the opening of the San Francisco light vessel fog-signal service May 1 is expected to mark the beginning of the "radioizing" of Pacific Coast lighthouses and ships, just as the three signal stations in the vicinity of New York, now in operation a year, marked the "radioizing" of the Atlantic coast beacons.

Scheme Entirely Possible

Wherever there are radio telegraph outfits, radiophones are possible, and, according to Commissioner Putnam, "the Lighthouse Service purposes, as means are available and needs are developed, to install similar groups or single radio fog-signal stations in the vicinity of important entrances on the Atlantic and Pacific coasts and on the Great Lakes, as well as on some of the principal intermediate capes and light vessels."

Lighthouse officials say they can readily see the introduction of radiophone receiving sets in many an isolated station, but the concerts made available to the keepers must be of the highest character, because "lighthouse keepers are usually old men of the sea, delighted with the security of their present stations, given to thinking serious thoughts, and very often highly educated through the slow process of years.

"The keeper of Tillamook Rock station, fifteen miles off the Oregon coast, on rocks so steep and in a sea so heavy that he must come and go by means of a basket swung far out from the ledge; and the keeper of Minot's Ledge, standing alone in the heavy sea, off the Massachusetts coast—on duty eight months of the year and off four months; and those keepers up in Alaska on duty three years running out of every four, would certainly enjoy sermons or concerts by radio.

Will Warn Vessels

"The proposed radio fog-signal service would operate in connection with the radio compass on ships at sea. By this means ships in heavy fog are accurately warned of the approach of other vessels. Fixed stations along the coast send certain fixed radio signals, such as a series of double dashes for 30 seconds and silent 30 seconds, as in the case of the San Francisco service about to be opened. By means of a chart, the captain of a fog-bound vessel is able to locate the source of these signals and thereby get his bearings.

As this service develops, all radio stations used therein will be built by the government and will be consequently powerful—using the long distance 1,000-meter wave length. Such stations would be able to receive concerts from a great distance. But the isolated lighthouse keeper, for the present at least, will have to rig up his own set out of his own pocket.

GET IN on This Special Short Term Subscription Offer

RADIO AGE

Five Months For A Dollar

Brimful of everything the Radio fan should know. Each issue a liberal education. Surely you will want the coming five numbers of RADIO AGE. It's 25 cents on the newsstands—$2.50 a year by subscription. Just pin a dollar (currency, check or money order) to this blank—mail today and we'll enter you for a five months' subscription—really ONE NUMBER FREE. Come on in.

RADIO AGE, *Circulation Department*, 64 West Randolph Street, CHICAGO

NAME.....STREET.....

CITY.....STATE.....

Steinmetz's Views

Two startling announcements—for those who could understand him —were contained in a lecture by Dr. Charles P. Steinmetz, electric scientist, delivered from a broadcasting station in New York recently.

They were: First, that radio waves and light are the same thing; second, that the theory of "ether" must be abandoned as unsound and unreasonable.

The only difference between radio and light, Dr. Steinmetz declared, is in the wave length. The wave over which he spoke to wireless fans, he explained, had a length of 360 meters. The wave length of a beam of light is only one twenty-thousandth of a centimeter. The wave length of the X-ray is 100 times shorter and, on the other hand, the electro-magnetic wave of long-distance transmission lines has a length of 5,500,000 meters.

"A radio wave passes through a brick wall," he said, "because the thickness of the wall is only a small fraction of the wave length, while a light wave is stopped by a thin sheet of metal because the thickness of even the thinnest sheet of metal is many times the wave length of a light wave."

Passing on to the question of ether, Dr. Steinmetz declared that "the belief in ether must be abandoned as being contradicted by Einstein's Theory of Relativity, which is now receiving general acceptance."

"For a long time we have believed," he said, "that light is a wave motion of some hypothetical thing, called the ether. This theory never was satisfactory, because it required that the ether must be so extremely thin that the earth and all bodies move through it with terrific speed—100,000 feet a second—without any trace of friction. And at the same time the ether must be a solid body of high rigidity. This is unreasonable."

Dr. Steinmetz explained the production of electro-magnetic waves which, "if they alternate about a million times a second are radio waves, and which, if they alternate nearly a hundred million of million times a second, form a beam of light.

"There is no such thing as the ether," he concluded, "and if in an attempt to be progressive we talk about ether waves and ether telegraphy, we are just the opposite—behind time."

A Showmen's Show in an Exposition Palace!
First Big Show in the Chicago-Northwest Field!
Will Operate Its Own Broadcasting Station for Exhibitors!

WISCONSIN RADIO SHOW

AND ELECTRICAL EXPOSITION

Auditorium, Milwaukee, Wis.

June 21st to 25th, Inc.

In Same Building on Same Dates

State Convention American Radio Relay League

Exhibitors Attention!

Milwaukee has **just** opened its **first** broadcasting station. Marquette University (Milwaukee) is set to go, and newspaper publishers are galloping about the East trying to buy broadcasting equipment.

In Wisconsin, one of the most prosperous states in the U. S., there are but 2,000 receiving sets! Michigan, 80 miles across the Lake, has 60,000!

By Show dates (June 21 to 25) Wisconsin will be at Radio Fever Heat. The local trade has been ultra-conservative, with the public clamoring for **more sets** and **more radio** information.

Who is to get the cream of the radio business in this great state?

The answer is written in the list of exhibitors who have signed for the Wisconsin Radio Show. If you are not in, wire for space and prices.

Our own broadcasting station in continuous operation assures every exhibitor opportunity for continuous demonstrations right in his booth. No magnavox annoyance. They must operate on schedule and for limited periods. Oceans of publicity, and guest tickets for your buyers.

WISCONSIN RADIO SHOW

Executive Headquarters, Plankington Hotel, Milwaukee, Wisconsin

SPEARMAN LEWIS
Managing Director

A. L. BARBOUR
Secretary

A. R. SHAFFER
Treasurer

Good Morning, Postman!

Mail from Montreal and mail from Amarillo, Texas. Letters from boys asking about crystal detectors, and delicately scented and tinted missives from matrons asking where they may buy radio receiving sets placed in good-looking cabinets for their comfy living rooms.

Letters from manufacturers asking where they can get bakelite. Letters from dealers asking for names of jobbers. Letters from amateur radio operators asking about new broadcasting stations and their call signals.

Letters from everybody about anything. All because Radio Age has been judiciously distributed over a carefully selected radio field. And because Radio Age is a quality magazine, costing 25 cents on the news stands. People do not buy a radio magazine at 25 cents unless they mean business.

Circulation is doubled on this June number. If so many hundreds of radio students and radio wise folk have taken what appears to be a permanent interest in Radio Age why shouldn't you give it a little serious attention, whether it is an instructive radio publication or simply an advertising medium you are after?

Just tell our postman.

RADIO AGE

The Magazine of the Hour

Garrick Building, Chicago

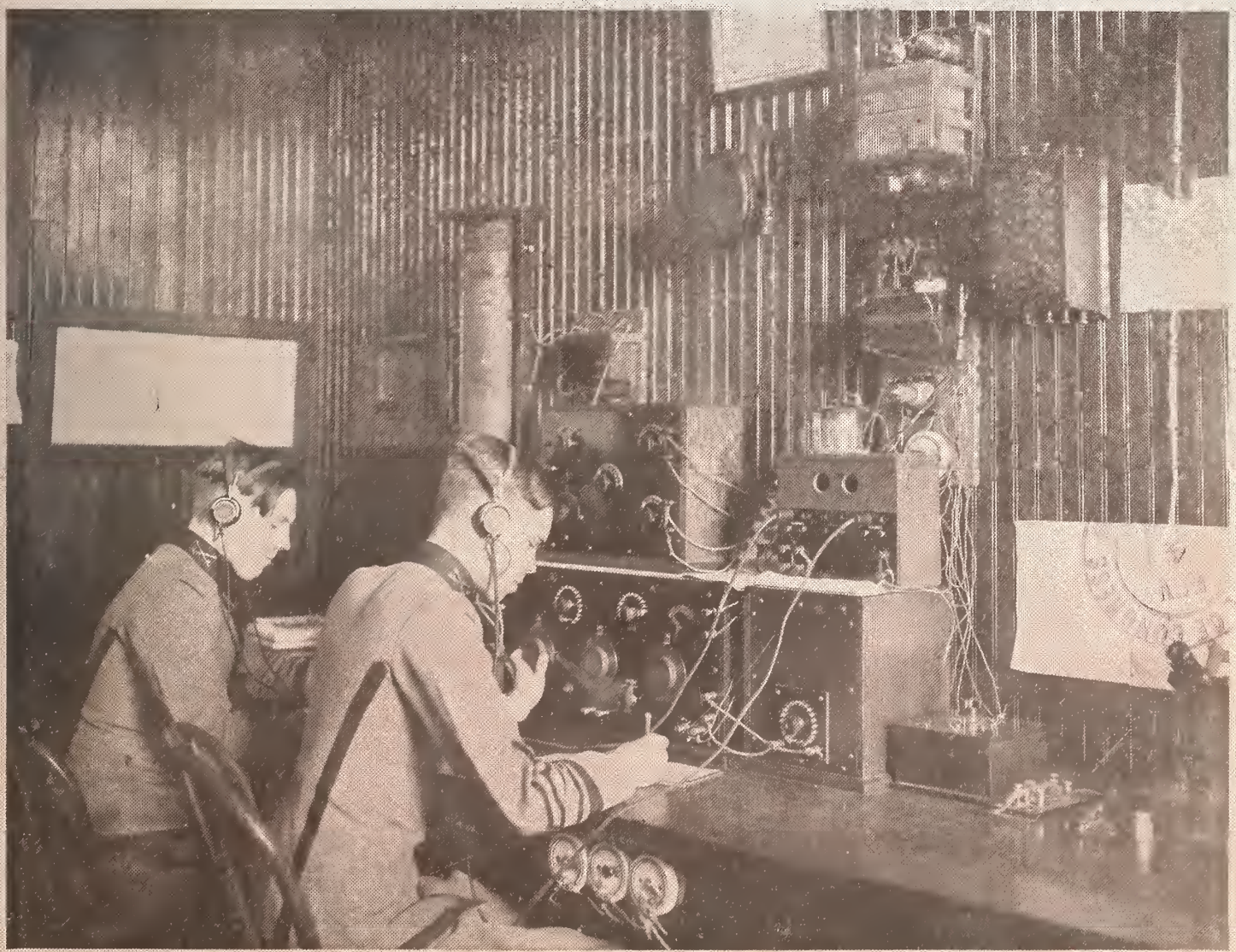
RADIO AGE

PACIFIC OCEAN

INDIAN OCEAN

The Magazine of the Hour

JULY-AUGUST, 1922 25c A COPY



Radio Students at Culver Academy

Introducing Mr. Pearne:

The portrait herewith is that of Frank D. Pearne, chief instructor in electricity at Lane Technical High School, Chicago.

Mr. Pearne is technical editor of Radio Age, and in that capacity he writes our leading technical article each month.

Also he answers all the questions the radio fans can ask, as a feature of the service department of Radio Age.

RADIO AGE

The Magazine of the Hour

Volume 1 *Number 3*

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If You Like Good News Read This Column

PUBLICATION was retarded this month for the dual purpose of carrying through the absorption of the entire subscription list of the National Radio Magazine, which has suspended publication, and rearranging the publication schedule. Hereafter advertising forms will close on the 19th of the month preceding date of publication.

July and August numbers are combined in this issue but neither subscribers nor advertisers will suffer thereby as contracts have been advanced one month to provide an additional number to subscribers, and a corresponding adjustment for advertisers.

Readers will observe that in this issue we announce the inauguration of RADIO INSTITUTE. Electrical experts will test Radio goods submitted to this institute, thereby supplying a valuable free service bureau to manufacturers and assuring readers that Radio products advertised in this publication are merit products.

If readers are not taking advantage of our free information service they are missing the facilities supplied by an office staff and by thorough radio experts. RADIO AGE welcomes inquiries from manufacturers, dealers and readers on any subject relating to Radio construction, operation or Radio trade.

Lack of space prevents publication of the promised article by the man who made his own receiving set, but the story of his adventures will appear later.

If RADIO AGE covers the news field this month tell your friends, if not, please tell our editor.

Who Said Radio's a Fad?

EVEN the advanced students of radio, the "hard-boiled," who can understand super-regeneration and all that bally high-brow stuff, got a real kick out of the demonstration several weeks ago in the court-yard of the Western Electric Company, at Hawthorne, Chicago. Charles G. Du Bois, president of the company, made an address to 27,000 employes who were assembled in the court yard of the Chicago plant. Mr. Du Bois was talking in New York, 1,000 miles distant, but his words were heard with perfect distinctness by the entire throng and by others who took up positions hundreds of feet away from the loud-speakers, that were set up especially for the occasion.

It was one of the most impressive demonstrations of radio possibilities. Read the details on another page.

RADIO AGE
"The Magazine of the Hour"
M. B. SMITH, PUBLISHER
PUBLISHED MONTHLY GARRICK BLD'G CHGO.
FREDERICK SMITH, EDITOR

How Radio Photograph Crossed the Atlantic in 40 Minutes

Arthur Korn's Achievement Is One of the Recent Amazing Developments of Wireless

By ARTHUR BENINGTON

THE World offers evidence of an extraordinary feat of modern science—the transmission by wireless telegraphy of a photograph from Rome, Italy, to Bar Harbor, Me., and its reproduction in New York.

The process by which this "miracle" was performed is the invention of Dr. Arthur Korn, professor of electro-physics at the Berlin High School of Technology.

When this photograph was "filed" at Rome no one in America had ever seen it. Forty minutes later it had been picked out of the ether on the Maine coast by Chief Radioman Edmund H. Hansen, U. S. N. From Bar Harbor to New York it had to be transmitted by mail, but from Rome to New York less than twenty-four hours elapsed.

The result of the experiment is far from perfect, but it points the way to an achievement that seems now to be in the near future. Over shorter distances and under more favorable conditions pictures have been transmitted and reproduced with surprising clarity of detail. The picture published herewith is evidence that the basic method is sound. The code message for the picture was sent from Rome to Nauven, Germany, and thence to Bar Harbor.

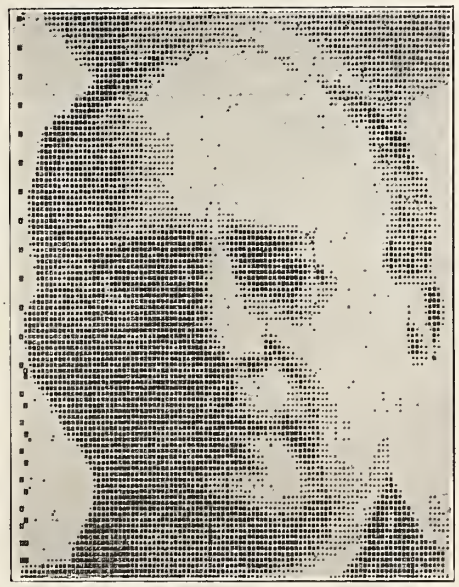
At Work Since 1900

Prof. Korn began working on his process in 1900.

Now Dr. Korn has developed for commercial use three distinct methods for the transmission of photographs. Two of these are for use over ordinary telegraph lines and one for use with Radio.

The first public demonstration of the Korn method of transmitting photographs through the air took place a few months ago in Rome, where in the presence of the King and Queen of Italy, a photograph was radioed to Berlin, where it was reproduced in a newspaper and actually on sale in the streets just one hour after the picture had been handed to the operator in Rome.

The New York World permits Radio Age to republish its description of the method by which a photograph was transmitted from Rome, Italy, to Bar Harbor, Maine. A reproduction of the photograph as received by radio in Bar Harbor is reprinted on this page.



Reproduction of photograph sent from Rome, Italy, to Bar Harbor, Maine, by Radio

The sending apparatus, as it exists now, is an exceedingly complex and bulky machine, built in Dr. Korn's laboratory for experimental purposes. The receiving machine is simple and portable, however. Without entering into a minute technical description of the process, the principles of it will easily be understood from the following:

How the Machine Works

If you look through a strong magnifying glass at a halftone picture in a newspaper or magazine you will observe it to be made up of a multiplicity of tiny dots, the very light parts being of small dots widely spaced, the very dark spots of larger dots close together. Prof. Korn, on analyzing photographs and halftones, realized that for practical purposes all the values of light and shade could be reproduced with from 15 to 20 sizes of dots.

Suppose, for example, we take seventeen different sizes of dots and give to each a letter, say A for the Smallest and P for the largest, the intermediate letters being for the intermediate shades. Now, if we can construct an apparatus which will automatically translate these seventeen values into seventeen corresponding letters and print these letters on a tape, we have a code which can be sent by wire or wireless to any place in the world, and if we have a typewriter that prints, instead of the letters indicated on the keys, the large or small dots which correspond to those letters, we can decode or translate that telegraphic or radiographic message into a half-tone picture.

This is just what Prof. Korn did.

As has been said, the machine which does the coding is quite complex. In making a halftone picture direct from a photograph, a wire

screen with larger or smaller mesh, according to the fineness of the half-tone desired, is placed over the face of the picture and a negative photograph is taken through the screen, thus producing the dots.

Light Turns the Trick

The Korn apparatus uses no screen, but a point of brilliant light traveling over the photograph, being cut on and off rhythmically by a commutator in such a way that it strikes the picture at accurately spaced points, working very much like the light of a moving picture machine. An ordinary cabinet size photograph receives the light at about 1,000 points.

The light passing through the negative falls upon a selenium cell, the quantity passing through depending on the darkness or lightness of the spot through which it passes. Selenium is a mineral crystal endowed with the peculiar property of passing an electric current only when exposed to light and of changing its electric resistance according to the degree of light that reaches it.

Prof. Korn makes use of selenium by placing a cell of it in the transparent cylinder on which the negative is coiled, and as the latter slowly revolves the light that passes through the negative falls on the selenium. a current of electricity from a battery passes through the selenium, and its resistance is varied by the values of the light.

Each variation of resistance—of which in this case there would be seventeen—controls a key which drops to print a letter on a tape the instant it is actuated by the electric current. The mechanism by which the present Korn machine does this is too complex to describe here; suffice to say that it prints the letter which corresponds to the particular shade of the photograph.

"Words" Transmit Pictures

In "coding" a picture we get about 1,000 letters. These are grouped by spacing into about 300 "words" which are sent by Radio (or by telegraph) to any place. They are received by an ordinary telegraph or Radio operator or by an automatic telegraphic receiving apparatus.

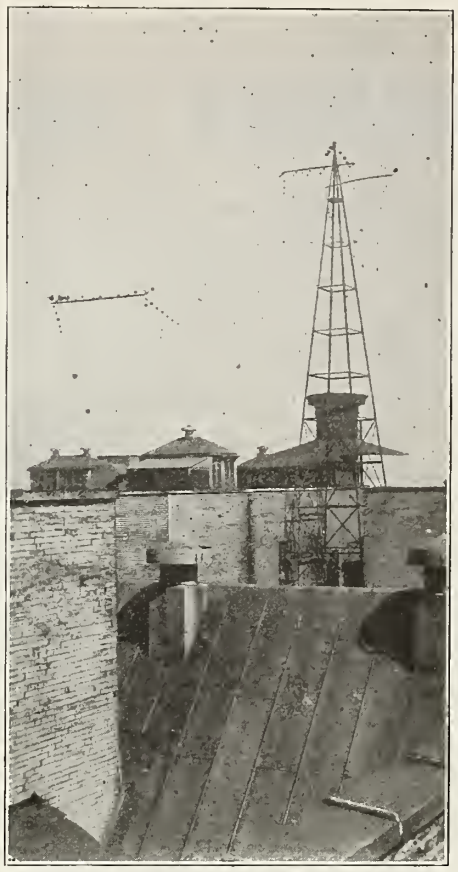
To decode or turn this word message back into a picture a Korn decoding instrument is necessary. This is a form of typewriter into which a sheet of paper about twelve by fifteen inches in size is placed. With the printed message before him the operator copies it on the keys; these, however, do not print letters, but dots of the sizes and shapes corresponding to the letters. As the code allows for the blank spaces between the dots the result is a very much enlarged half-tone of the original photograph, and this needs only to be photographed down to the size wanted by the paper; the smaller it is the finer the half-tone. This decoding instrument may be attached to an automatic telegraph receiving machine in such a way that the code letters are entirely cut out and the telegraph machine prints the dots directly.

There are at present only two sets of Dr. Korn's apparatus in existence; one of these is in Germany, the sending machine, and the other is at Dr. Korn's laboratory at Centocelle, near Rome, and the receiving or decoding instrument is in America.

Governments Aided in Test

Through the courtesy of the Italian Ministry of Marine and the American Navy Department The World was able to obtain this unique picture. As related in The World in May, Commendatore Pascale sent a photograph of the king of Italy from Rome as one of the tests made by the navy, but the navy gave no publicity to this, and had it not been for the vigilance of Beatrice Baskerville, The World's staff correspondent at Rome, the American press might never have known of it.

The World thereupon asked the Navy Department to permit the use of the Korn receiving machine at Bar Harbor for the reception of a picture by Radio from Rome. The department replied that as the instrument was the property of the Italian Ministry of Marine, the consent of this latter must first be obtained. After a few days of cabling back and forth, the Naval Attache of the American Embassy in Rome cabled the Navy Department that the Italian Ministry consented.



Station WBU is of a temporary construction, and was constructed for experimental work to determine features and characteristics required for a permanent installation. It is located on the roof of the City Hall, which is 200 feet above street level. The steel tower supporting the antennae is 70 feet high, making a total height of 270 feet above street level. Two six wire antennae are used, respectively 75 feet and 160 feet long, each consisting of six wires composed of phosphor bronze 7-strand No. 18 B. & S. gauge wire. The transmitter is a modified De Forest OT-201 transmitter rated at 1 K.W., having special grid modulation system.

Pittsburgh's "Radio Day"

By **C. E. URBAN**
Radio Editor, Pittsburgh Gazette

"RADIO DAY" is the name given by the Radio Engineering Society of Pittsburgh to a day set aside each year for an outing of the radio fans of Pittsburgh and vicinity. The idea originated with the above society when it held the first "Radio Day" in Pittsburgh on August 17th, 1919, attended by a small group of radio enthusiasts. The annual radio outing of the Society has since been a regular event each year and has met with widespread popular approval.

From a small group of "Old Timers" in the amateur radio fraternity of this locality who attended the first modest gathering, the attendance at these annual outings of the Radio Engineering Society each succeeding year has grown to such proportions that it was deemed necessary by the Society to arrange for the exclusive use of a large amusement park this season to accommodate the crowds it is confidently expected will turn out for the occasion.

The committee in charge of the affair is composed of the following officers and members of the Radio Engineering Society: W. K. Thomas, Chairman; C. E. Urban, Secretary; M. Hirsch, Treasurer: Dr. Omar T. Cruikshank, Guy Davis, W. E. Menges, John B. Coleman, C. C. Young, John Schaming and Thomas McLean.

Exhibition by Dealers

Pittsburgh's "Radio Day" will be held August 24th, 1922, at Westview Park, which is ideally situated and adapted for the purpose. A program of events is being planned that is literally "Chock-full" of Novelty, Pep, and Entertainment. Many new and interesting radio contests are being scheduled with prices for the winners that will cause a scramble of applicants to participate.

The prizes will be donated by the various local radio dealers and manufacturers who will stage an exhibition of the latest developments in radio appliances covering three hundred square feet of space in two large Exhibition Halls on the grounds. Some of the dealers have started a movement to have all radio stores in the Pittsburgh district close on the day of the outing, and will insert placards in their windows bearing the inscription:

"This Store Will Close August 24th,
'RADIO DAY'
Meet us in Westview Park"

Super-Regeneration Secret Revealed

Major Armstrong Explains How Amazing Amplification of 1,000,000 Times Is Achieved

A "Super-regenerative" receiver so sensitive that no aerial nor even a loop is necessary if the set is within twenty miles of a broadcasting station is the amazing achievement of Major Edward H. Armstrong long known to the wireless world as a genius. But the most astoundnig feature of Major Armstrong's arrangement is that his device will amplify sound one million times or more with the use of only two vacuum tubes.

This revolutionary circuit is a simple line-up of apparatus that accomplishes the same results heretofore achieved only by eight vacuum tubes hooked up in a bewildering series of inductances, capacities and resistances.

And yet, in spite of this great sensitivity, it is not too critical in adjustment, and the circuit can be understood by the average radio amateur, says Lloyd Jacquet in the New York Evening Mail Radio Review. The apparatus needed can be easily procured and can be connected in the very simple way which Major Armstrong shows in his circuit diagrams.

Armstrong Reveals Secret

The mystery of the whole circuit rests in the correct values for the various pieces of apparatus. It is very necessary that the right size coils, the correct capacities, and the proper kind of batteries be used. All of this information has now been released by Major Armstrong for the first time, and the necessary data for the construction and operation of the super-regenerative receiver are contained in the following paragraphs.

It was by the extremely clever application of the further effects of regeneration that Major Armstrong was able to obtain amplification of signals from 100,000 to 1,000,000 times in practice, and in theory beyond that. In describing the underlying principle, Major Armstrong recently said:

"I will describe a method of regeneration based fundamentally on regeneration, but which involves the application of a principle and the attainment of a result which is believed to be new. This new result is obtained by the extension of regeneration into a field which lies beyond that hitherto considered. The process of amplification is therefore termed 'super-regeneration.'"

To make this clear to the layman:

Every amateur who has a regenerative receiver knows what happens when the knob of the tickler is turned too far. There is a distinct "squeal" or "howl," which can be eliminated after careful tuning. While tuning in a signal it is found that there is a gradual increase in signal strength until a point is reached where the strength becomes very great. This is the point just before the noise begins. If it were possible to remove this noise, there is no reason to believe that implification could not continue on indefinitely. This in plain language was the fundamental theory on which Armstrong worked. This next step he explained as follows:

"The expedient by which oscillations are stopped is known as 'super-regeneration.' The trick is to balance the feedback against the damping of the circuit. When the regeneration overcomes the damping the oscillations stop, but the amplification continues. It is then possible to continue amplifying by the phenomenon of regeneration, and there is no theoretical limit to the amplification obtainable."

Three Methods Possible

In practice there are three ways in which this "balancing" feat may be accomplished. First, by varying the feedback with respect to the damping; second, by varying the damping with respect to the feedback, and lastly, by varying both together with respect to each other. The new principle, then, is as follows: A very critical regenerative circuit is so adjusted that it is responsive to infinitely small electrical impulses or changes. It will then be extremely sensitive to changes from a very small negative resistance to a very small positive resistance, and vice versa. This change is controlled by the oscillator tube, at audio, sub-audio or super-audio frequencies. The super-regenerative receiver passes cyclically from one to the other, and while this change takes place the regenerative tube gives out a series of strong oscillations at any desired frequency.

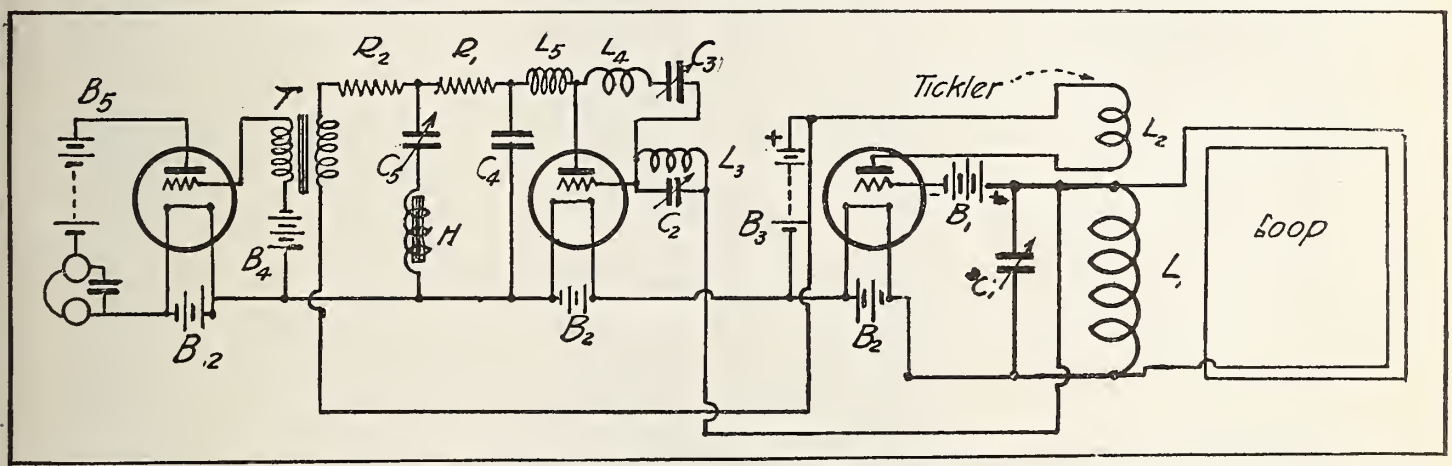


Diagram of the super-regenerative circuit designed by Major Armstrong especially for broadcast reception, showing units and connections: 1. L-1—Primary of 150 to 700 meter vario-coupler; L-2—Tickler coil. Ball of secondary of vario-coupler rewound twice the number of turns; L3—Duolateral coil 1,250; L-4—5 Millihenry choke; L-5—Duolateral coil 1,500; C-1—.001 variable condenser; C-2—.0025 fixed (or variable) condenser; C-3—.001 variable condenser; C-4—.005 phone condenser; C-5—.005 variable condenser; R-1 and R-2—12,000 ohms Lavite iron core resistances; B-1—Biasing battery 1 to 5 volts; B-2—Filament battery, 6 volts; B-3—Plate battery, 80 to 100 volts; B-4—20 volt block battery; B-5—100 to 200 volts; H—.1 henry choke with iron core; T—Audio frequency amplifying transformer; Loop—12 turns of wire on three-foot frame.

In the first experimental circuits set up by Major Armstrong it was necessary to use one tube as the regenerator, another as an oscillator excited by E. M. F. of suitable frequency. Later experiments permitted the combination of the two actions, with only one tube used to detect, regenerate and produce the necessary oscillations.

This is not the simplest kind of a super-regenerative receiver to begin with, however, for the adjustments and controls are rather delicate and critical. For the radio fan who wants to try out the new type of receiver Major Armstrong has for the first time made public the correct values and data for the installation of a super-regenerative set suitable for broadcast listening in.

It will tune up to 700 meters without any additional loading coils.

The loop used by Major Armstrong in the demonstration was a 3-foot loop, wound with twelve turns of stranded single-wire lampcord, in a flat plane. From seven to twelve turns may be used, and bell wire is suitable for winding. The loop is connected in parallel to the primary of an ordinary vario-coupler. A condenser of .001 microfarad is used to tune up the loop circuit and is absolutely necessary. The tickler is made from the secondary of the loose coupler. The secondary ball is rewound to twice its capacity; that is, twice as much wire is placed on it.

Parallel Connection Beat

This loop may be connected in series with the primary of the vario-coupler, but it seems to work better when in a parallel connection. The two coils L-3 and L-5 need not be placed in an inductive relation to each other. In fact, they can be placed anywhere without affecting the proper working of the set. The two small resistances which form part of the filter system are of 12,000 ohms resistance each and made of Lavite with iron cores. None of these values are critical. The rest of the filter system comprises the 0.1 henry choke and the variable condenser C-5. This choke may have a value between ½ and 1½ henries, and its effect may be controlled by the variable condenser C-5.

The first tube in the circuit is made to act as the regenerator, with the second tube as the oscillator. The third tube is an audio frequency amplifier and is connected in the regular way. The last tube may be left out if desired, but in that case it will be difficult for experimenters to tune the set, which will be very critical in adjustment. (This course is not recommended, but if the audio frequency amplifier circuit is omitted the phones should be connected across the .005 fixed condenser at C-4.) In constructing the three-tube set, hard tubes—that is, amplifier tubes—should be used throughout the circuit. In actual demonstrations Western Electric "L" type tubes were used by Major Armstrong. Radiotrons U. V. 201 are very serviceable for the set, as well as any other tube with a high vacuum, which will withstand high voltages without ionizing.

Recommends "A" Battery

One filament battery may be used by merely connecting the filaments and rheostats in parallel, such as in any ordinary amplifier circuit. The use of individual A batteries is recommended, however.

If it is desired to use only one B battery, this may be done by connecting the phone lead from the plate circuit of the last tube to the 100 volts on the first tube. Instead of using the biasing negative C battery in the grid circuit of the first tube, the potential from the B battery in that circuit may be used by tapping it off at the convenient point.

Major Armstrong also gave pointers on the tuning of his super-regenerative receiver. First, of course, the loop should be pointed in the direction from which the signals are emanating. Then the loop and primary circuits should be tuned to the frequency of the incoming wave with condenser C-1. This condenser is generally set for a value of .004 microfarad. This part of the circuit is the ordinary regenerative receiver, and the first tube, therefore, acts as a detector and regenerator. The condenser across the second tube is set to the correct value, and once adjusted need never be changed again. This value depends upon the kind and type of vacuum tube used, so that no actual capacity can be given. This can only be determined by experimenting. The condenser C-5 is next adjusted, and its setting need not be changed either. These are the preliminary adjustments. Once these have been made there remain but two elements to tune, the loop circuit and the feedback.

The loop circuit is tuned by means of the variable condenser C-1, and the variation in feedback is obtained by moving the coil L-2 nearer to or further away from coil L-1. These are practically the only remaining adjustments to make.

Not for Novices

Some difficulty may be experienced at first in getting the set tuned for a particular station. After patient adjustment of the controls, this will be possible. It must be remembered that this is not a set for absolute novices and that some knowledge of the vacuum tube and its circuits is necessary for obtaining any sort of results.

While the possibilities of the super-regenerative receiver are unlimited, there are certain phases in radio receiving which must be considered. There is no doubt that the new type of receiver has amplifying capabilities far beyond that of any method employing but two or three vacuum tubes. For those who want signal strength in preference to distance, the super-regenerative receiver will serve them best. For those who like to cover as much distance as possible with their equipment, the Armstrong super-heterodyne is still the standard for performance.

Amateurs should bear this in mind before expending much time and energy and money on a wild goose chase.

Visit the Radio Club

The Radio Club of Illinois, of which Radio Age had an interesting description last month, is now located in a new and attractive home at 16 East Ontario street, Chicago. The culb is only five minutes' walk from the loop district and keeps its doors open twenty four hours a day. The restaurant is open from 12 o'clock noon, to 2 o'clock a. m.

Initiation fees, including a year's dues, a lapel button and a year's membership are all supplied for $10 and all the privileges of the club are available to all members.

It is pointed out by Mr. John Tansey, secretary of the club, that the radio rendezvous is a good place for visitors to the coming Pageant of Progress to meet their fellow radio fans. Non-resident members to a limited number can be accommodated with sleeping apartments at $1.50 a day. The non-resident membership list is limited to 100 and the officers of the club suggest that it would be well for prospective applications for membership to be in as soon as possible.

Peoria Firm Aggressive

The United States Electrical Supply Co. (Incorporated) of Peoria, Ill., has sent out 100,000 radio sheets to individuals and companies in fifteen states. The electrical and telephone supplies, including a large number of radio specialties are illustrated and described on a large folded sheet which is equivalent to a catalogue containing 250 pages.

The City of Chicago in Radio

THE City of Chicago has for its motto "I WILL," and it is this spirit that prevails in the pioneer work that the City of Chicago is doing to apply radio to its various municipal activities. The radio activities are under the jurisdiction of Mr. George E. Carlson, Commissioner of Gas and Electricity, who is an ardent radio "fan." Mr. Carlson believes that one of the great future uses of radio communication will be in coordinating the police work of cities and other municipalities. Incidentally, it can be used to coordinate other governmental functions, broadcast public addresses, governmental information and provide entertainment. Mr. Carlson says "Chicago was a pioneer in electric street lighting and electric fire alarm and police signal systems, and it will try to maintain its past record in being one of the first in radio."

What is believed to be the first municipal radio station in the United States was established on the roof of the City Hall in Chicago as early as June 1921, and operated as an experimental station with the call letters 9 XAM. A second station was installed in the Englewood Fire Alarm Office at 64th street and Wentworth avenue, with the call letters 9 XAN, and about eight miles distant from the City Hall. Radiotelephony communication was carried on between these two stations mainly for the purpose of demonstrating to municipal officials and heads of city departments interested in special applications of radio. Development work was begun to provide transmitting and receiving apparatus for police automobiles, so called "bandit cars," and this effort was carried forward to successful demonstration.

Civic Education

In March of this year, broadcasting in Chicago had reached a climax, and many requests were made by citizens and organizations that the City of Chicago use its radio station to broadcast addresses and talks by municipal officials and leading citizens on subjects of municipal and community interest. Accordingly on Sunday, March 12th, at 6:30 p. m., Commissioner George E. Carlson gave the first address from the City Hall Radio Station (which now had the call letters WBU) on the subject "Municipal Radio." At 7:15 p. m., the same evening, Dr. John H. Williamson, Commissioner of Law Enforcement of the City of Chicago, on "Crime and the City Council," followed. Since this auspicious opening, many leading public officials and citizens have presented subjects to the people of Chicago and surroundings from station WBU. Representative speakers and subjects have been as follows:

Dr. William J. Hickson, Psychopathic Laboratory of the City of Chicago. "The Cause of Crime."

George E. Carlson, Engineer of Gas and Electricity, Chicago. Ardent Radio Fan

Dr. John Dill Robertson, President Pageant of Progress Exposition. "Invitation to America to attend the Pageant of Progress."

Chief John C. McDonnell, Chicago Fire Department. "Fire Prevention."

Dr. Herman N. Bundeson, Commissioner of Health, City of Chicago. "Community Health a Community Asset."

Mr. Victor H. Tousley, Chief Inspector, Department of Gas and Electricity, City of Chicago. "Electrical Inspection."

Col. Frank L. Smith, Chairman, Illinois Commerce Commission "Good Citizenship."

Postmaster, Arthur C. Lueder. "How You Can Help the Chicago Post Office."

The first woman to give an address from station WBU was Miss Elizabeth Cleveland, R. N., Department of Health, City of Chicago. "Public Health Nursing."

Sports have also formed some of the features and have included:

Mr. Frank McNichols. "Semi-Professional Baseball."

Mr. Dan B. Starkey, Editor of "Outers Recreation." "Why you should make your boy a Fisherman."

Mr. Frank Pasdeloup, President Chicago Bowling Association. "Something about Bowling."

Mr. J. C. Hail, electrical engineer in the Department of Gas and Electricity, has been placed in charge of radio development and operation, and the broadcasting programs are under his direction. Mr. Edwin K. Oxner is associated in the capacity of Radio Engineer.

Other Practical Uses

Station WBU broadcasts police and health bulletins at 10:15 a.m., 12:45 p.m. and 4:45 p.m., daily except Sundays and holidays. Police bulletins include missing persons, stolen automobile numbers, and other items of police information. The health bulletins include conditions of water supply, milk supply, health conditions throughout the city, and any other seasonable health information or "helps" that may benefit the community. Feature speakers are broadcasted tri-weekly on Monday, Wednesday and Friday of each week, at 3:30 p.m. and also at 7:30 p.m. Wave length is 360 meters.

Station 9XB is the experimental police automobile "bandit car," and on the basis of the results attained to date, Commissioner George E. Carlson has requested an appropriation of $68,000.00 to provide a continuous operating police dispatching station suitable for 24-hour service, and transmitting and receiving equipment for eight police automobile "bandit cars." The Finance Committee of the City Council of the City of Chicago has the matter scheduled for early consideration.

The Chicago police radio experiments have attracted attention all over the world and many other cities have made plans to use wireless as a police aid if the Chicago test proves it practicable.

Addresses 27,000 Across 1,000 Miles of Ether

President of Western Electric Company Telephones to Chicago Employes

FOR the first time in history the president of a great corporation has been able, talking from his office, to address in person several thousand of his fellow employees, 1,000 miles away, at the same time and in such a fashion that all of them heard distinctly every word he uttered. Charles G. DuBois, President of the Western Electric Company has set the unique example that is attracting widespread attention among other industrial leaders who now see the way cleared for more intimate contact with their fellow employees. The day when they required several weeks to tour the country meeting the scattered personnel of their organizations has passed.

In upsetting tradition Mr. DuBois spoke from his offices at 195 Broadway, New York City to 27,000 workers gathered in the courtyard of the Western Electric plant in Chicago. Transmitted into an ordinary telephone his greetings were carried by long distance telephone over New York, New Jersey, Pennsylvania, Ohio, and Indiana to Chicago and delivered through amplifiers and a loud speaking apparatus erected on a platform in the factory precincts so that every one within a quarter of a mile from the receiving equipment, listened in without the slightest difficulty.

The audience was also addressed by H. B. Thayer, President of the American Telephone and Telegraph Company, and F. B. Jewett, Vice President of the Western Electric Company, talking from New York; and J. C. Nowell, Vice President of the Pacific Telephone and Telegraph Company, speaking directly from San Francisco, more than 2,000 miles away.

Visitors gathered at Chicago for the experiment were amazed by the clearness of tone and the volume of sound obtained in the amplification of the addresses. To impress upon the audience the power of the loud speakers, H. F. Albright, Vice President of the company introduced one of the officials at the factory who talked with and without the aid of the loud speakers.

When he addressed the gathering without the aid of the equipment he was heard scarcely twenty feet from the stand. Then, as the amplifier was switched on, his voice was carried out over the crowd until it reached the most distant corner of the plant.

Edwin K. Oxner, Radio Engineer, Chicago Municipal Broadcasting Station

A remarkable degree of amplification was possible with the apparatus installed for the demonstration. As a matter of fact the energy delivered to the loud-speaking receivers in the horns was 18,750,000,000 (18¾ billion) times that received over the long-distance wires, but it was necessary to use somewhat less than three-fourths of this capacity.

Officers of the Chicago Telephone Company who were present at the Western Electric demonstration were so impressed by its effect upon the factory employees that they are arranging for a similarly addressed meeting of their own personnel at Chicago. Description of this will be published in a later issue of Radio Age. It seems likely that telephoning in job lots will become a popular business feature.

Mr. Harding's Loud Speaker

ONCE again science has been called upon to help President Harding put over a message to the people. To insure perfect speaking conditions for their favorite son during the many festivities of Marion Homecoming Week, July 4 to 10, when Mr. Harding's neighbors turned out in full force to render him homage, the business leaders of his home town ordered the installation of a public address system. The equipment was capable of throwing the chief executive's voice out over an area of 100,000 square feet, or a space large enough to accommodate about 45,000 listeners.

When the Marion programme was originally planned it was estimated that the President would address about 25,000 people. Led to reconsider their estimates as a result of the enthusiasm manifested by Mr. Harding's friends in all the counties surrounding Marion, the promoters of the homecoming week were forced to augment their original plans. They instructed the engineers of the Western Electric Company who handled the installation of the amplifying apparatus to arrange their equipment in a fashion that would permit the extension of the system, if necessary, to accommodate a crowd of even larger proportions. Bell System engineers demonstrated their ability to throw the voice over great distances recently when a voice, amplified by their methods, was heard without the aid of any receiving apparatus—radio or otherwise—at a spot five miles away.

President Harding, who was the first prominent public official in the world's history to take advantage of the opportunity the loud speaker presents to address vast assemblages, promises to go down into future age as the Stentor of the White House. Where the famous old Greek was said to be possessed of a voice as loud as that of fifty men, Mr. Harding's vocal efforts have been magnified billions and billions of times. In his inaugural address he was aided by the Bell Loud Speaker in reaching the ears of practically everybody in one of the greatest gatherings ever seen in Washington.

Radio Celebrities at Pageant Show

Chicago Convention to Attract Nationally Known Electrical Wizards

THE fastest radio operators in America, if not in the world, together with the world's greatest experts in the radio development and construction field, are to attend the International Radio Congress, August 6, 7 and 8, held in connection with Chicago's second annual international Pageant of Progress Exposition on the Municipal Pier.

Maj. J. O. Mauborgne, signal officer of the Sixth Army Corps Area, located at Chicago, and associated with Maj.-Gen. George O. Squier, chief signal officer of the United States Army, is president of the congress and will preside at the main sessions, of which there will be five. The details of arrangements are in the hands of a committee of Chicago radio men, headed by Commissioner George E. Carlson, of the department of electricity of the city of Chicago, and head of the Chicago Municipal Radio station, as chairman.

Among the noted radio developers expected to take part in the congress are Maj. Gen. Squier, Charles P. Steinmets, Senator Guglielmo Marconi, Edwin H. Armstrong, inventor of the regenerative circuit, Dr. Louis Coen, F. W. Dunmore, and Dr. J. H. Dillinter of the United States Bureau of standards, and others.

Race for Operators

One of the exciting features of the congress will be a radio Marathon for a diamond medal to be held Sunday morning, Aug. 6 and participated in by the fastest receiving operators that can be assembled. The rules of the contest as outlined by the officials of the congress and by Lawrence R. Schmitt, U. S. Radio Inspector for the Ninth Radio District, who will supervise the event, include the following:

The contest is for reception only in the Continental code and the copy received will be straight commercial press which will be transcribed on regulation Western Union typewriters.

The diamond medal, valued at several hundred dollars, is donated by Commissioner Carlson. Applications for entry should be addressed to him at Room 614, City Hall, Chicago. Applicants must give their name, address, business connection, age and previous records. The contest will be an elimination affair.

Some records are expected to be broken as the set up will be calculated to permit the greatest speed. Some of the best previous records made in the Continental code include:

Fifty-six and one-half words a minute. Made by L. R. McElroy of Boston, at the 71st Regiment Armory Radio show in New York in May. This is the fastest work recorded.

J. C. Hail, Electrical Engineer in charge of Radio Development and Operation of Chicago Municipal Broadcasting Programs

Forty-nine and one-half words a minute. Made by Jose Seron of New York.

Forty-eight and three-fifths words a minute. Made by B. G. Seutter of New York.

Entry in the contest is open to all expert receivers of the Continental code and every arrangement is being made by Inspector Schmitt for the convenience and comfort of the entrants.

There will be sessions of the International Radio Congress Monday morning and afternoon, August 7, and also on Tuesday.

Thirty Nations Represented

Thirty nations of the world will take part in the second annual Chicago pageant from July 29 to August 14. There will be three and one-half miles of commercial and industrial exhibits, making what was conceived originally as a distinctly local show an international fair that promises to rival and possibly surpass the great fairs at Prague, Leipsig, and Lyons.

Last year no effort was made to give the exposition more than a middle west interest but exhibitors booked orders from such far points as South Africa and Alaska, China and Norway, and a dozen other countries. This revealed to Mayor William Hale Thompson, originator of the pageant, and Dr. John Dill Robertson, president, its possibilities. This year they expect the foreign trade opened up to merchants and manufacturers of America to run into the millions of dollars.

Exhibitors in the first show subscribed for space in a great measure as a civic duty, many doubting that the financial returns would justify the expenditure of time and money necessary to make the displays their pride demanded but determined to do their utmost to insure success for any enterprise undertaken by Chicago. To the gratification of all they found they had erred. Orders poured in. Factories which were running on part time, plants on the verge of closing down completely signed contracts for their products that assured operation for months at capacity.

This year there was a rush of exhibitors for space. Ninety per cent of those with displays last year renewed their contracts. The remaining ten per cent of space went in a hurry and weeks in advance of the opening date not a foot was left.

Girl Wins Scholarship

Miss Emily Doser, a shop worker at the plant of the Western Electric Company at Chicago has been awarded a scholarship at the newly opened school at Bryn Mawr College. Miss Doser is one of the six Chicago girls selected for the ten weeks course. She has been an employee of the Western Electric Company for about a year and a half.

Woman's Part in Radio

Address by Miss Elizabeth A. Bergner, Lane Technical High School Instructor, Before Exhibitors at Leiter Building Exposition

I THINK you have all heard of the woman in radio who thinks a detector is some kind of a detective, and that an umbrella aerial is the kind they use in countries where it rains a great deal. Usually you think of her as being the woman radio fan or operator, but I think you will find her mostly in the funny column. I think if you have ever talked to a woman operator or any woman who is at all interested in radio, that you have found she is extremely serious about the possibilities of radio. She is just about as serious, at least, as her small brother, and the chances are about ten to one she is a great deal more serious about radio and its possibilities than her grown up brothers or friends. She thinks in radio terms, she believes in radio, she feels the need of radio, and I believe that radio also needs her.

Probably any woman who becomes at all interested in radio follows the path of the small boy in listening to somebody else's sets, perhaps a set one of her friends has. You and I can understand she is very greatly interested, for instance, in the concerts that come over the aerial. The chances are her interest is so great she very speedily acquires a set of her own, probably sooner than the boy who is interested in that. From that point the interest grows so great, her desires to get all she can out of it is so great, that I suppose she goes on by leaps and bounds, if she is to become what we call a radio fan.

Probably the first idea that a woman has of the possibilities of radio, is its use in her home. She is interested in bringing her friends in to hear the concerts. It appeals to her as a source of social communication, if you will. She is interested in it for herself. She likes the programs that come over, she feels she can get a great deal out of them. Broadcasting stations are sending out a great many programs during the day for women, and for women alone.

I think the selfish element, however, of the woman entertaining herself or entertaining her friends, if you call that selfish, is not the one that appeals the most to a woman. And here I think the women can understand best when I ask the question, "How many ever consider the possibility of keeping the boy home at nights by giving him even the simplest of radio sets to play with and work with?" You have probably tried it. If you haven't tried it, I advise you to do it. If you are up against the problem of keeping boys in at nights, keeping them off the streets, just get a radio set or one for your home; it is inexpensive, and certainly the expense is absolutely negligible if taken into account at all in comparison with the good it does to your boy. They tell me the same thing works with husbands, but I cannot speak from experience there.

Gradually,—well, I should say very suddenly, you get the desire to find out what the dots and dashes are. You know very few people like to listen to the other fellow talking all the time, and that is, of course, what you are doing in radio receiving; you are listening to what the station sends you, and you have to take what they send you.

Of course, you can turn off your tubes, but then you are worse off than you were before. But you want to get to the point where you can talk with the other fellow, where you can create something, and that, after all, is the great pleasure in being able to send, to use a key and talk to the other fellow. Just how much you create is, of course, another matter. But that desire is there. And so a woman is attracted by these dots and dashes and the possibility of being able to talk, and then, of course, from that point on, she will work towards this end. That is, if she makes up her mind that she wants to do this, the probabilities are that she will keep at it until she does learn it.

From this point, of course, she gains more or less rapidly the technique necessary, and finally she becomes a full-fledged operator, either amateur or commercial.

Now, of course, the two fields are extremely different. In the amateur field there is no compensation other than the pleasure that you derive from it. There is no money compensation. However, in amateur work, as well as in commercial work, woman is taking a leading place, I think. We hear of an Assistant Traffic Manager in the West. I can quote an instance in Washington, Miss Winnie Dow. If you don't know what a traffic manager is, it is simply a question of assisting, in part, the radio inspector, I believe, to keep order in the air and also to help in handling messages from one part of the country to the other. That, of course, is merely amateur work, though it is an executive position and one which it is hard to find a person to fill.

We have Mrs. Candell, Assistant Superintendant of Ohio, who also has such an executive position.

However, in the commercial field the opportunities are even greater, and here, of course, the greatest interest is aroused in a woman. Time after time letters come to me asking me just the posibilities for women in the commercial field. In New York we have a woman who examines the ship stations for sailings. We have an assistant examiner in that capacity in Boston. In Boston we have a society woman who is interested in forming a large radio company for radio supplies.

Advance Schedule of Radio Shows

Electrical Exhibit at Pageant of Progress, Municipal Pier, Chicago, July 29-Aug. 14.

State Fair, Marshall, Mich., Sept. 1-10.

Toronto Radio Convention—Late in summer.

Cincinnati Radio-Electrical Exposition, Oct. 2-7.

Chicago Radio Show, Coliseum, Oct. 14-22.

Chicago-National Radio Exposition, week of January 15.

Radio Needs Trained Men

Radio is sweeping the country like wild fire. Thousands of dollars are being spent for expensive outfits. RADIO EXPERTS are needed everywhere to keep this equipment in order and to sell and install new outfits.

Be a Radio Expert

I will train you quickly and easily in your spare time, to become a RADIO EXPERT so you can install, construct, repair and sell Radio equipment. I am a **Graduate Electrical Engineer** and from actual experience I will give you exactly what you must know to make the really **big money in radio.**

FREE My Consultation Service to you is FREE. This outside help which I gladly give you is, in itself, worth more than the small cost of the Complete Course.

START NOW

Don't let others beat you to the big money. **Start now** and within a few weeks' time I will train you at home, at an amazingly low cost, to become a RADIO EXPERT. Write for **"Radio Facts"** sent **free** without obligation.

A. G. MOHAUPT, Electrical Engineer
American Electrical Association
4513 N. Winchester Ave., Chicago

WRITE TODAY

Application of the Vacuum Tube to Radio Circuits and Apparatus

By FRANK D. PEARNE

Chief Instructor in Electricity at Lane Technical High School, Chicago

IT is only within the last few years that the great value of the vacuum tube in the radio field has been known. Dr. J. A. Fleming, of London, was the first to discover the rectifying nature of this form of detector when he made his "glow lamp oscillation detector," which name he adopted because he discovered that this lamp would conduct electric currents in one direction, better than another, through a vacuum.

From that time on inventors in almost every country in the world worked on the development of this greatest of all additions to the art of oscillation detection, until today we have it perfected to such a point that it is used in many different capacities in radio work, among which are detectors, amplifiers, rectifiers, oscillation generators and modulators.

In order that the reader may fully understand these different applications of the vacuum tube, it is necessary that he know something of the electron theory which makes possible the conduction of the electric current from the plate to the filament.

The Electron Theory

The smallest known element of electricity is the electron. An atom of any particular element consists of many thousands of electrons, which are always of negative polarity. The exact number and arrangement of these electrons are definite for any particular element. Now we must consider any atom as being made up of a definite number of electrons, and if any of these electrons become detached, or attached to an atom (that is giving it more or less than its definite number) the atom then displays the same properties as an electrically charged body. When the electrons become detached, the atom becomes what is known as a "positive ion," and it will then act the same as a positively charged body, but if more electrons become attached to the atoms, it then acts as a negatively charged body, and the atom becomes what is known as a "negative ion."

From this it will be seen that when an atom becomes charged with electricity, it becomes either a positive or negative ion, depending upon whether electrons have become attached or detached from it, and if a stream of these electrons can be carried from one point to another it constitutes an electric current flowing between the two points. It makes no difference whether or not these electrons are carried in the form of actual electrons, positive ions, or negative ions, except as regards the direction of the current.

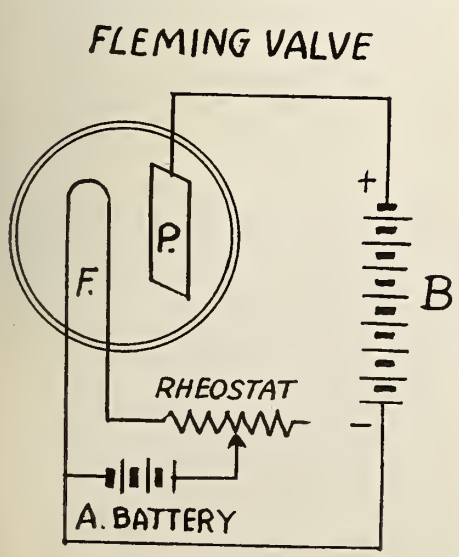


FIGURE 1.

Dr. Fleming's Valves

If a piece of metal is placed in a vacuum and heated to incandescence the electrons of which the particles of metal are formed become loosened and become, to some extent, free to move about. If a metal filament and a metal plate are placed in a vacuum with some source of electricity applied to heat the filament, and an electrical pressure is exerted between the plate and the filament in such a way that the plate is positively charged, quite a number of the electrons which are loosened from the filament will be attracted to the plate. By this action of the electrons, the space between the plate and the filament becomes a conductor, but only in one direction. This is because the electrons which are liberated from the hot filament are negatively charged, and negative electricity only can pass from the filament to the plate, which is the same thing as positive electricity flowing from the plate.

Figure 1 is a diagram of such an arrangement. When the filament is rendered incandescent, current flows from the positive terminal of the battery "B" to the plate "P," through the stream of electrons to the filament and back to the negative terminal of the battery "B." If the current from the battery is reversed in direction, no current will pass between the plate and the filament, for the reason that the plate will then be charged with negative electricity, which will tend to repel the negatively charged electrons instead of attracting them, hence it will be seen that should an alternating current be applied to the plate and filament, current could only pass between them at such a time as the positive impulse was impressed upon the plate, the negative part of the cycle would not pass.

Thus the vacuum tube becomes a rectifier of the alternating current; that is, regardless of the fact that alternating current is being applied to the tube, a direct current consisting of many impulses per second will pass through the circuit.

A diagram of the alternating current wave is shown at "A," Figure 2, while "B" in the same figure shows the rectified half of the wave, and the dotted lines show the half

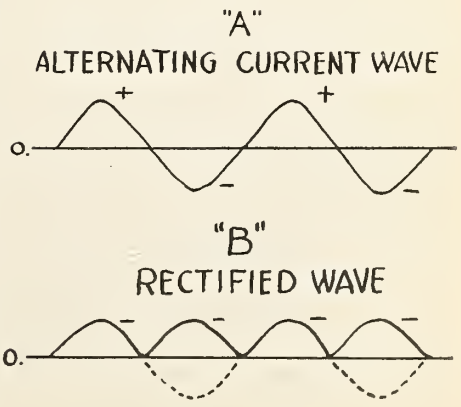


FIGURE 2.

of the wave which does not pass. Arrangements of this kind have been put upon the market for charging storage batteries from alternating current lighting mains, and are called rectifiers.

Now, while it is true that this Fleming valve will only conduct electricity in one direction, it is also a fact that only a limited amount of current can flow through the valve, for the reason that the number of electrons liberated from the filament per second is limited, and consequently no matter how high the applied alternating current voltage may be, only a certain amount of current can flow. As the number of electrons liberated per second will depend upon the size of the filament and the temperature to which it is heated, these valves are constructed in several different sizes, according to the amount of current which they are to pass.

The Amplifying, or Magnifying Valve

One of the main characteristics of the Fleming, or two-element valve, is the fact that it does not obey "Ohm's law," which states that the amount of current flowing in a circuit is directly proportional to the applied pressure and the resistance of the circuit. In the case of the Fleming valve, the plate current is not proportional to the plate voltage except within a very limited range of values of the latter.

This is true also of the "triode," or three-element valve, which is used for many different purposes. This triode valve is the same thing as a two-element tube, with an additional element interposed between the filament and the plate. This new element is called the "grid," which is composed of either a perforated plate, or more often, a simple screen of nickel wire. It is not connected to anything inside the tube, but is connected to a terminal in the base by means of a single wire. This addition of the grid to the Fleming valve was the one thing which revolutionized the art of radio telegraphy and telephony, and practically made a new science. By making the plate more or less positive (within certain limits) the plate current can be increased or decreased, and the same effect can be obtained by keeping the plate voltage constant and merely supplying a more or less positive or negative charge to the grid.

The reason for this is easily understood; the grid is directly in the path of the electrons which are traveling to the plate, on account of its positive charge; the electrons, or at least a great number of them, pass through the openings in the grid.

Now if the grid was given a slight positive charge, it also would attract electrons from the filament, which would increase the total number of electrons in the stream, which would also increase the amount of current flowing from the plate to the filament, but if on the other hand a slight negative charge was applied to the grid, some of the electrons would be repelled and the total number in the stream would be made less, then the amount of current flowing from the plate would be decreased. A saturation point is reached, just the same as in a two-element tube. The attainment of this value is assisted by the absorption of some of the electrons by the grid itself, when it is positively charged. The more positive the grid is charged the more electrons it will absorb, and consequently the current flowing from the plate will be just that much less, but as the current in the grid circuit due to absorption of electrons is so extremely small, it means very little in the ordinary triode tube, and need be only considered where large-sized tubes are employed.

Grid's Balancing Point

When the tube is to be used for detection and amplification, the circuit is so arranged that the grid charge is produced by the incoming signals, which, when they strike the grid as oscillations, will increase or decrease the flow of electrons to the plate and cause a consequent increase or decrease in the current flowing from the plate.

Now it has been discovered by experiment that each and every tube has a critical point, at which a very slight change in the charge on the grid will make enormous changes in the flow of electrons, and consequently the current flowing in the plate circuit may be made to vary to a great extent by extremely weak changes in the charge received upon the grid. In order that this effect may be utilized to the fullest extent, the grid is usually charged artificially to just the balancing point, so that any incoming signals of a very weak form will upset this balance and make very large changes in the plate current. Now it is easy to understand how, if a pair of head phones are connected in the plate circuit, very weak incoming signals will be greatly magnified in the receivers, making it possible to receive them quite loud in the receivers when it would be impossible to detect them with a crystal detector.

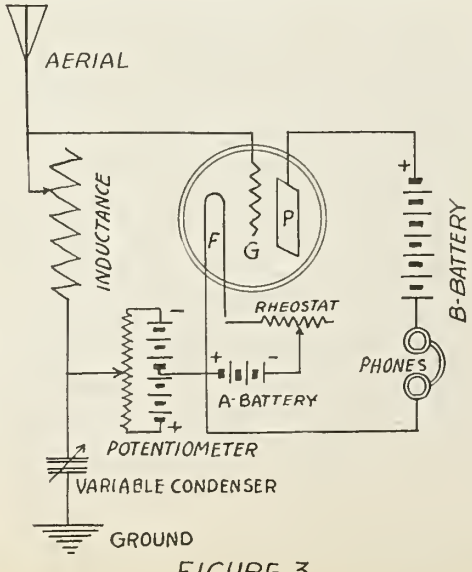


FIGURE 3

The variation in the artificial charge placed on the grid to obtain the balance is accomplished by means of a potentiometer connected across another battery, as shown in the circuit Figure 3.

By means of this potentiometer the pressure between the grid and the filament can be varied from a negative value of say 10 volts when the slider is on one end of the potentiometer, to a positive value of 10 volts when the slider is on the other end, thereby allowing the grid potential to be varied to any desired value between these two limits. While this method is very good for adjustments where it is desired to increase the sensitiveness of the set to a very fine point, still many of the more modern sets do not use this extra battery for loading the grid.

Figure 4 is a chart showing the curve of a typical valve of comparatively small dimensions, such as would be used for receiving sets having a battery of 100 volts applied between the plate and the filament. The horizontal line represents the artificial charge on the grid, which is supplied by the potentiometer, and the vertical line shows the change which takes place in the current in the plate circuit by the variation in the charge applied to the grid. For example, it will be seen that with a negative grid charge of between 6 and 8 volts shown at "A," the knee of the curve is found, and any slight change tending to cut down the negative charge will cause a considerable rise in the plate current, and if the incoming signals which strike the grid can be made to reduce the negative charge from "A" to "0" and

(Continued on page 24)

Radio Equipment at KDKA

By D. G. LITTLE

Radio Engineer, Westinghouse Electric & Manufacturing Company

WITH the increasing popularity of radio broadcasting a description of station KD KA at East Pittsburgh, Pa., will be of interest to the general public, a large number of whom are already acquainted with the station through their receiving sets. KDKA opened November 5, 1920, with the broadcasting of the presidential election returns that day.

The power of KDKA was at first relatively small, on the order of 100 watts being delivered to the antenna. In August, 1921, the range of the station was increased by improving the height of the antenna and raising the power output first to 500 watts and subsequently to 1,000 watts.

In keeping with the growth of the station, a special studio was arranged for the artists and announcer, particular attention being given to the acoustic properties, so that echos, reverberation and other disturbances have been largely eliminated. The quality of transmission from this station has been improved at every opportunity by means of the studio, and by improvement in the apparatus. The usual carbon microphone has been replaced by a condenser type transmitter for picking up the sound waves. Resistance coupled amplifiers are employed for increasing the relatively weak output of the pick-up transmitter to a power sufficient to control the radio set.

The natural oscillating frequency of all the units in the pick-up and amplifier system has been placed, so far as possible, outside of the audio frequency range, so that the radio signal is practically a perfect reproduction of the original sound. Special filter circuits are arranged to eliminate generator hum in the power supply to the radio transmitter. As broadcasting becomes less a novelty and more a practical form of entertainment, the high quality of KDKA's programs is being greatly appreciated. After over a year of operation this audience is very exacting as to the quality of reproduction and arrangement of the programs.

How Current Is Changed

The path of the speaker's voice from the studio to the receiving station is shown in diagrammatical form in Fig. 2. The sound wave picked-up by the transmitter in the studio, theatre or church is amplified before it is transmitted by means of a telephone line to the radio station, where it is further amplified and used to control the output of the radio transmitter. The radio transmitting set is supplied with power directly from the work's power plant through a step down transformer for the vacuum tube filaments and through special motor generator sets, which change the 220 volts, direct-current to 2,000 volts direct current for the tube plates.

Fig. 5—Oscillogram of Rectified Antenna Current for Modulation of Vowel A

The radio transmitter changes this power from 2,000 volts direct-current to alternating-current power at a frequency of 833,000 cycles per second (360 meters wave length) which is supplied to the radiating system, consisting of an antenna and counterpoise. This high frequency power in the antenna system sets up waves in the ether, which travel outward in all directions and, intercepting the receiving antenna, set up voltages and currents which operate the receiving sets.

Fig. 1—Percy Hemus, Baritone, and Gladys Craven, Pianiste

A general view of the radio transmitter now in use at KDKA is shown in Fig. 3. This set furnishes about one kilowatt high frequency power to the antenna. Fig. 4 shows the circuit diagram. For convenience in studying the circuits represented by Fig. 4, which carry a wide variety of frequency, this diagram has been divided into four sections by means of the dotted lines at the right. The lower section, which may be considered as the power supply, carries only direct current at 2,000 volts and low-voltage alternating current at 25 cycles. This 25 cycle current is used only for heating the filaments. To prevent any of the 25 cycle current being superimposed on the grid-filament and plate filament circuit, the return of the grid circuits and the 2,000 volt circuit is connected to the mid point of a resist r, which is shunted across the filament, each half of the resistor being shunted by a condenser for by-passing the radio and audio frequency circuits.

In the next section of Fig. 3, in

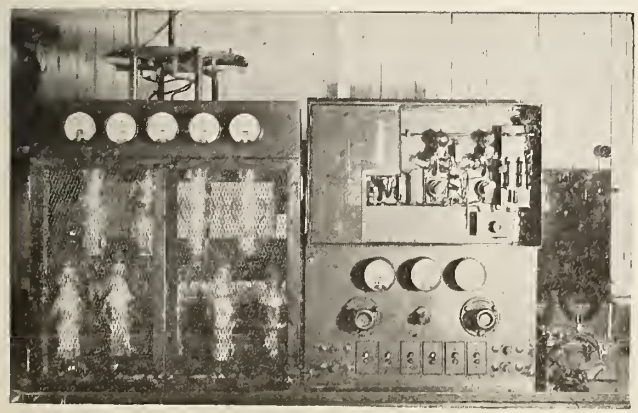


Fig. 3—General View of Equipment in the Operating Room

addition to the power circuits described, audio frequency voltage is impressed upon the girds of the modulator tubes, varying the potential of these grids with respect to their filaments according to the voice waves, through the medium of the pick-up transformer and amplifiers.

The four 250 watt power tubes in the upper part of the set are the oscillators, which, in conjunction with the condensers and oscillation transformer, change the 2,000 volt direct-current powers into alternating-current power at 833,000 cycles, thus generating the carrier wave, which is impressed on the antenna through a remote controlled double throw switch, which allows the same antenna to be used for receiving when the station is not broadcasting. The amplitude of the radio frequency wave thus generated is constant as long as the plate voltage remains constant, and fluctuates with the plate voltage when the latter is varied.

Thus the upper section of Fig. 4 carries only modulated radio frequency waves, while the third section carries both radio frequency and audio frequencies, in addition to the 2,000 volt direct-current and the 25 cycle alternating-current power circuits.

Power Modulation

The function of the five modulator tubes, also rated at 250 watts each, is to vary the voltage on the plates of the oscillator tubes according to the voice frequency impressed upon their grids by the speech amplifiers. This system is known as power modulation, the modulation being accomplished by means of the constant choke oil in series with the positive lead to the modulator and oscillator tube plates. The modulator tube grids are held at a static potential of 80 volts negative with respect to their filaments by means of a battery. (See Figure 6.)

The audio frequency from the speech amplifier then adds to or subtracts from this 80 volt grid potential. At an instant when the modulator tube grids have impressed upon them by the amplifiers a low negative, or zero potential with respect to their filaments, the tube impedances from the plate to the filament are low and a large plate current flows in the 2,000 volt direct-current circuit to the modulator tube plates.

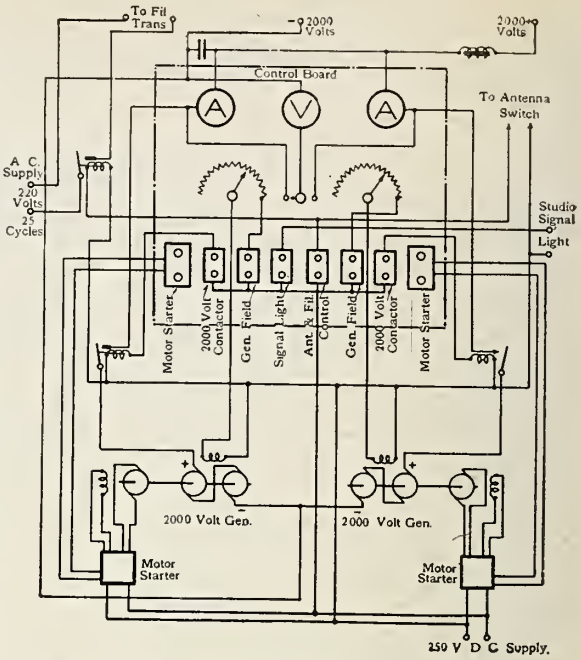


Fig. 1—Circuit Diagram of Power Equipment

Because of the very large inductance (50 henries) of the audio frequency choke coils in series with the plate supply, the total generator current can change very little in a brief interval of time. Hence, part of the generator voltage occurs across the choke coils, thus lowering the voltage impressed on the oscillator tube plates and hence the radio frequency output of the set. The next instant when the modulator tube grids have a high potential with respect to their filaments, the plate impedances are high and little or no current flows through the modulator tubes.

The choke coils, tending always to keep the total generator current constant, create a voltage which adds to the generator voltage and thus forces most of the current into the oscillator tubes, which increases the radio frequency or antenna output accordingly. In this way the audio frequency choke coils cause the voltage applied to the oscillator tube plates to fluctuate in proportion to the speech voltage impressed on the grids of the modulator tubes by the speech amplifier. As the amplitude of current in the antenna varies directly with the plate voltage on the oscillator tubes and as this voltage varies from nearly zero to 4,000 volts, the antenna current varies accordingly.

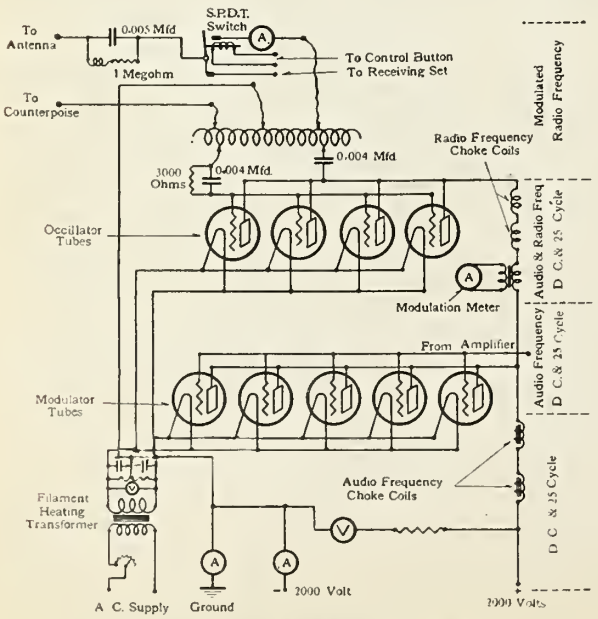


Fig. 4—Hook-Up of Broadcasting Transmitter

Fig. 5 shows an oscillogram of rectified antenna current taken when the announcer is speaking loudly into the pick-up transmitter. It is seen that the antenna current varies from nearly zero to nearly twice its no talk value. This variation in antenna current at voice frequency is known as modulation.

The radio frequency choke coils in series with the oscillator tube plates serve to stop any radio frequency from entering the modulator and power supply circuits. These choke coils are of air core construction and are about five millihenries inductance each. They thus offer a high impedance to the radio frequency, but negligible impedance to the audio frequency.

In order to indicate the amount of modulation, a so-called modulation meter has been developed. This consists of a current transformer, the primary of which is connected in series with the direct-current supply to the oscillator tube plates and the secondary of which is connected to a thermo-ammeter.

Meters in Abundance

The transformer ratio is such that an audio frequency variation in the direct-current from zero to twice its normal value gives full scale deflection. An air-gap is provided in the transformer core to prevent saturation due to the direct-current component of the plate current. The meter has a current scale marked from 0 to 100 percent modulation. When the announcer is speaking into the transmitter, the modulation

meter averages about 40 percent with maximum between 70 and 80 percent. Piano solos average about 30 percent, violin solos 20 to 30 percent and vocal numbers 40 to 50 percent with maximum of 100 percent.

Of course the modulation meter indicates only the average volume of sound. While the meter may read only 30 percent in case of piano music, the individual notes at the instant of striking may reach 80 to 90 percent.

Allowing for the kind of sound being transmitted, that is, piano, speaking voice, solo, etc., the modulation meter provides a convenient means of finding the correct distance to place the artist from the pick-up transmitter and accounts to a large extent for the uniform volume of sound received from KDKA. The instruments at the top of the transmitter panel, Fig. 3 are from left to right, filament volt meter, ground current meter, plate ammeter modulation meter and plate volt meter. The antenna current meter is mounted on the wall with a series condenser and discharge resistance and is not shown in the photograph.

The antenna at KDKA consists of 6 wires, 190 feet in length on 20 feet spreaders. This antenna is supported 210 feet above the ground by a brick smoke stack at one end and by a 100 foot pipe mast on a nine story building at the other end. The operating room and studio are located on the ninth floor of this building. Fig. 6 shows the mast end of the antenna with the operating room directly below. A counterpoise which is a duplicate of the antenna in construction is placed 110 feet beneath the antenna. This brings the counterpoise about 15 feet below the transmitting set.

The down lead from the antenna and the counterpoise lead are made up of eight strands of No. 14 copper wire equally spaced around 1.5 in. diameter wooden spacers. The natural period of this aerial system is approximately 412 meters. A series condenser of 0.0005 mf. capacity is used in series with the antenna and sufficient loading inductance added to obtain the desired wave length of 360 meters. The series condenser is shunted by a radio frequency choke coil of 10 millihenries inductance in series with a one megohm resistance, to drain off any static charge that might accumulate on the antenna when

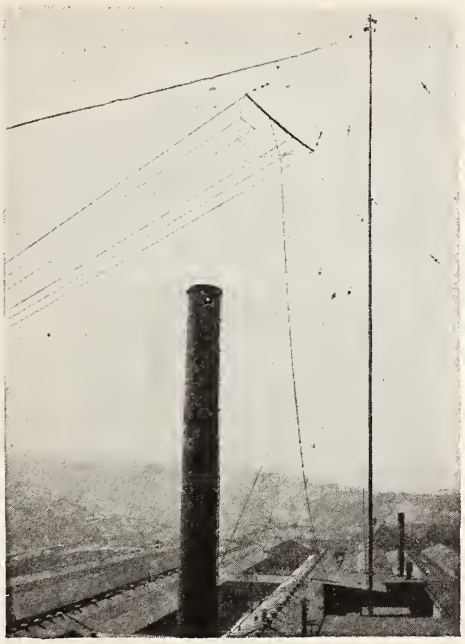


Fig. 6—Antenna at KDKA

insulated from ground by the series condenser. The high frequency resistance of the antenna system at 360 meters wave length is approximately 12 ohms, a large percentage of which is radiation resistance. The antenna current at 500 watts is 6.5 amperes; at one kilowatt it is 9 amperes.

Three Motor Generators

The power equipment consists of two 2 kw. motor generator sets with 250 volt direct-current motors. The current employing two armature windings and two commutators permanently connected in series. Normally the motor generator sets are used with the generators paralleled.

Either set may be used alone with the radio set at reduced power. There is also a third motor generator set with a 220 volt 25 cycle motor which can be connected to the radio set in case of failure of the direct-current supply. This set is provided with an exciter to supply the field of the high voltage generator. A filter consisting of a 50 henry inductance and 32 microfarad condenser reduces the generator hum to a negligible amount.

The panel beneath the speech amplifier on the right in Fig. 2 controls the power equipment. Here are mounted generator field switches and rheostats, generator paralleling switches, generator voltmeter and ammeters, voltmeter switch, antenna switch control and studio signal light button to show the announcer in the studio when the transmitting set is in operation.

The engineer in charge of the station tests all filament and plate batteries before each program. He next starts the transmitting set and checks the wave length by means of a wave meter. He then lights the signal light in the studio, notifying the announcer that the transmitter is in operation. The announcer turns on the studio amplifier which lights a signal light in the operating room, notifying the engineer that the audio circuits are in operation. The engineer then watches the modulation meter and adjusts the amplification of the speech amplifier to give the desired amount of modulation. A loud speaking receiver in the operating room serves as a check on the quality of the transmission. When programs from local churches or from the downtown studio are to be transmitted, the telephone line is tested before the program. Orders and any special arrangements are made over a supplementary order wire or phone line between the radio station and place of the performance.

In the concert room the music or speech to be transmitted is recorded on the microphone transmitters by vibration of the diaphragm, one transmitter being used for each instrument, vocalist or speaker.

The recently inaugurated market quotations service is designed for the especial benefit of the farmers, merchants, brokers, co-operative growing and marketing associations, etc.

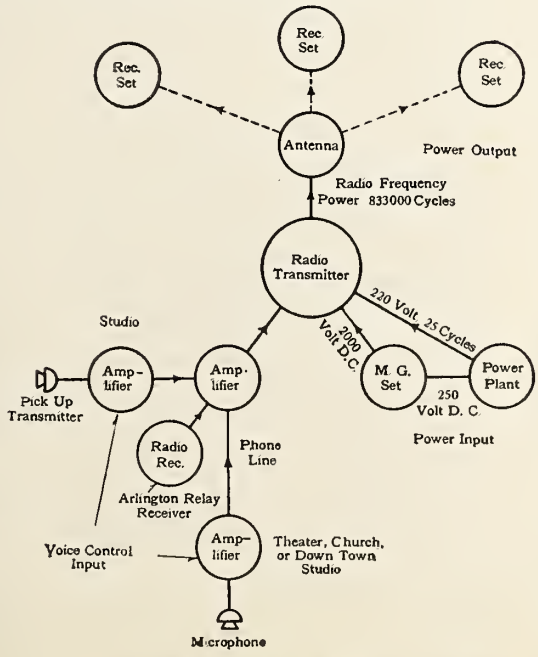


Fig. 2—Schematic Diagram of Radio Broadcasting Station

Radio Progress Around the World

IN view of the often repeated and perfectly true assertion that the United States leads the world in radio advancement and number of radio students it is interesting to note what some foreign countries are doing with wireless.

The United States government maintains radio stations at Porto Rico, the Canal Zone, Guantanamo, Cordova, Alaska; St. Paul, Pribilof Islands; Honolulu, Guam, Samoa, Tutila, Cavite, Philippine Islands; Vladivostok and Peking, and through foreign stations of the international chain has communication with every part of the world. A special station of high power is maintained at Coblenz for the use of the American troops there.

Norway

A new radio station is being built in Norway on the summit of Rundemandon, a 2,500-foot mountain near Gergen, with the hope that radio communication between the United States and Norway may be established. The station is designed to have a 3,000 kilometer telegraph radius and an 800 kilometer phone radius. With the phone verbal communication will be held with England. The station will be ready in August, according to expectations.

China

Negotiations between the Chinese government and an American company have been completed whereby China will have within the next two years a complete system of radio communication facilities, which will include one station as large as any at present in existence.

The contract covers the erection of five radio stations, the first to be built at Shanghai. This station will consist of six towers, each 1,006 feet in height. The equipment will include two 1,000 watt arc sets, and will operate on a single-wave system.

In other parts of the world, too, the construction of wireless stations is progressing at a great rate. The zone of radio telegraph stations is constantly being enlarged, each week bringing reports of new and remote lands reached.

South Atlantic

The British island of Tristan da Cunha, in the middle of the South Atlantic, with its 120 odd souls, mostly descendants of Napoleon's St. Helena guards, who hardly hear from civilization more than once in two years, is at last to have a missionary and radio communication.

Tristan da Cunha is a mountain, 4,000 feet high, rising out of the ocean wastes like an inverted pudding bowl, and, as we saw it, was wreathed in swirling mists. The little colony lives in stone huts on a green strip of pasture land at the foot of the mountain.

Having no commerce and no money, these people certainly cannot worship Mammon, but it is doubtful if they worship God. The two plucky missionaries who have exiled themselves among them for at least two years will try to teach them. They brought large quantities of supplies and civilized comforts and a radio set, so that henceforth Tristan da Cunha will not be cut off entirely from the outside world.

Australia

The preliminary work of establishing the huge Australian radio station for direct communication with Great Britain has been begun at Melbourne.

The sub-stations for overseas traffic will be about three times as powerful as any European station today. It will take two years before the central and feeder stations are completed. As a normal performance the chief station will be able to speak direct over 12,000 miles for the greater part of any working day.

Receiving and sending stations to correspond will be built in Canada during the same period. The plant for the main station will be imported from England, but the plant for the feeder stations will be manufactured in Australia, one for each of the states.

The combined cost of all these stations will be about $5,000,000. The main station will consist of a transmitter and receiver terminal thirty miles apart, the latter including twenty-four towers each 800 feet high, spread over a square mile. The wireless rates will be one-third less than the present cable rates to Europe.

Canada

The Canadian law, in effect on June 1, reads:

"Every person operating a receiving equipment must have a license; the fee is $1 per annum and is used to assist in paying the expenses necessary to maintain the inspection staff for the patrolling of the ether so that the reception of broadcasted radio concerts and programs may not be interfered with by irregularly operated transmitting stations.

"Effective June 1, 1922, the naval department announces that all nationality restrictions in connection with radio receiving licenses are canceled and that henceforth any person, irrespective of nationality, may obtain a 'receiving license.' The restriction limiting the issue of transmitting licenses to British subjects remains in force."

Brazil

Brazil is installing the most complete cable and radio system in South America, Charge d'Affaires Crosby at Rio de Janeiro reported to the commerce department.

"It is believed," he said, "that during the present year the development of cable and radio facilities in Brazil by American, British, French, German and Italian companies will give that country the most complete system of international communication in South America."

Belgium

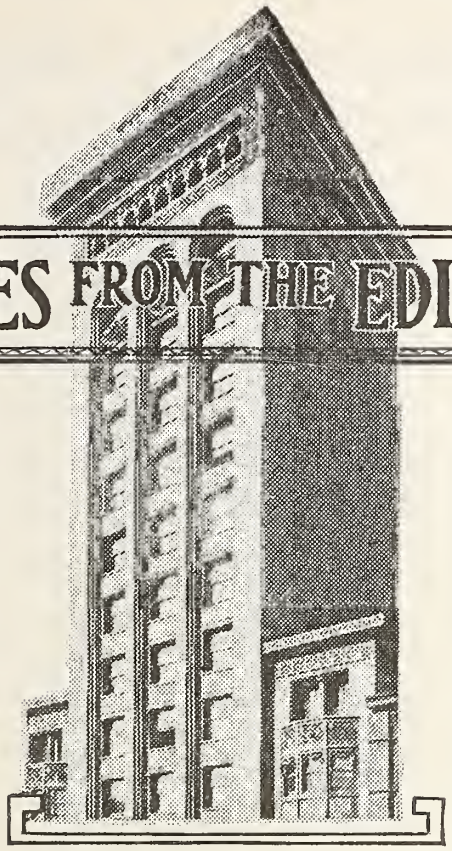
Radio telephony is still an unknown science in Belgium. Only recently King Albert listened to his first aerial conversation—a message from the Eiffel tower in Paris.

The Belgians have not yet fallen victims to the craze that has spread thru the United States during the last few months. There is not a single radio telephone broadcasting station in Belgium, the few more scientific persons who have built receiving equipment depending entirely upon Paris and Scheveiningen in Holland for their entertainment. Such is the unique picture of aerial communication conditions in the little kingdom as pictured by L. Van Dyck, chief of the production branch of the Bell Telephone Manufacturing company at Antwerp, who has come to the United States to study methods at the company's factory at Chicago.

Expects Much from United States

"Belgium," Mr. Van Dyck declares, "has acquired the habit of looking to the United States for all suggestions in electrical matters. Once the radio telephone has proved its feasibility as a commercial enterprise here, Belgium undoubtedly will take steps to adopt it."

Clapp-Eastham Company, 139 Main Street, Cambridge, Mass., have issued an attractive, informative and comprehensive catalogue of Radio, Electrical and Laboratory Apparatus under the title of Bulletin FZ-1922, Fourth Edition.



THOUGHT WAVES FROM THE EDITORIAL TOWER

WE commend to all readers the article published in this number of Radio Age on "The Development of Radiophone Broadcasting." In our June number we published an article on the Washington conference which decided for certain wave allotments and other limitations respecting broadcasting service. We published this information probably more extensively than any other radio periodical for the reason that we regarded the subject as of paramount importance in all lines of radio. At least it appealed to us more than did some material which came to hand regarding the attachment of a radio receiving set to milady's garter.

The article published in this number was written by Mr. L. R. Krumm, who was a radio man with the Signal Corps for eighteen months in France. Mr. Krumm knows what he is talking about. He is with the Westinghouse Company. It is not surprising that, because of his affiliation with that great corporation, he should have some definite ideas on broadcasting privileges, public and private. He sets forth frankly the attitude of himself and presumably of the Westinghouse organization and that makes interesting reading, whether we all agree with him or not.

If any reader has another side of the question to present we shall be glad to publish it and we have no doubt Mr. Krumm will be among thousands to read it with interest.

Surface thinkers have been saying, these hot days, that radio is done for. No interest in radio, they proclaim. Just a passing fad, as they thought all along. Here is a word to you fellows who let the summer doldrums make you think that the world is all awry. If you will step into the office of Radio Age we will show you files of correspondence that prove there is, at this peak of the torrid season, a very lively and substantial interest in radio all over our blessed old United States. The croakers who talk about summer static making radio transmission a flivver in the summer and the tragic glooms who spin terrible yarns about the danger of lightning in connection with radiophony have the wrong ticket and they are not even in the right laundry. Hundreds of thousands of men and boys, and an amazing number of women and girls, are building and using their radio outfits. Vacation journeys and motor rides, baseball thrills, fishing expeditions and picnics take Americans away from their homes during the hotter weeks of the year and when the folks are away from their homes they are away from radio, as a rule. However, they are going to troop back to their bakelite panels and their tubes and crystal detectors within a few weeks. Antennae are going to cobweb the city roofs and the country dooryards this fall. Programs broadcast from the rapidly growing number of stations are going to be improved until they will enlist the interest and enthusiasm of a big share of our urban and rural population. Some of the smartest capitalists in the country are throwing millions into radio activities. Radio manufacturers are a tremendous industry, not prospective but actually existing. Meet us at the fall and winter radio shows and give us a chance to say "We told you so."

If you read the official government article in this number which sets forth how radio transmission is being used to disseminate market quotations, weather news and crop reports, you probably will not be surprised that the United State Government is a confirmed radio optimist. The article predicts that the radiophone is to become as common as the telephone. There are many farmer boys on our subscription list and if they do not read that government article they will miss something every country boy should know. And for that matter the facts therein will help the city boys, too. Likewise city grown-ups.

In its issue of May 12 the London Daily Express tells under first page headlines its enterprise and the new era of news dissemination inaugurated by it in broadcasting the Carpentier-Lewis fight.

The Daily Express evidently has not heard of the strides American newspapers have made in the use of radio. Read what the London Journalist wrote on May 12, 1922:

"A wonderful and romantic new era was inaugurated by the Daily Express last night, when, for the first time in the history of the world, a newspaper broadcasted news of universal interest by wireless telephone. The event marks an epoch in the progress of human communications.

"Dempsey, the champion, described the fight between Carpentier and Lewis not only for our readers, but to the multitude of wireless telephone users in Great Britain and the continent.

"His story of the sensational fight was converted by the ordinary telephone from Olympia, where the fight took place, to the Daily Express broadcasting station at Slough, the headquarters of the Radio Communication Company, and thence sent through the ether to an eager, waiting world."

Questions and Answers

This Department Conducted by FRANK D. PEARNE, Technical Editor of RADIO AGE and Chief Instructor in Electricity at Lane Technical High School, Chicago

A. L. W. Jr. St. Louis, Mo.

Question: In your June issue the enclosed circuit was printed and I am of the mind to try it, but am uncertain as to the accuracy of the diagram.

Referring to the first page of amplification you will note that one side of the amplifying transformer goes to terminal "A," other side "B" to a bus terminal leading to a battery and primary of No. 2 transformer; terminal "C" from detector to a bus terminal leading to No. 2 transformer primary and phone terminal, the phone terminal being one side of the battery. Now what I wish to know is, if using only one stage is the battery to flow through the phones without any controlling device and what size is the battery, that is, how many cells? If using 2 stages must the phone terminals which I just spoke of be connected together? If you can make this clear I will be greatly obliged to you. Am having good success with crystal detectors and like the clearness in preference to the screech of most audion sets.

Answer: Not being familiar with this circuit, I have compared it with that shown in the June issue and find that your sketch is correct. In answer to your first question it seems to me that the battery should be used as you suggest, although I must admit that I cannot see just what action takes place unless the second crystal not only acts as a rectifier but also varies the battery current through the phones, in which case it would seem that a carborundum crystal would work best at this point. In case two stages are used the phone terminals would have to be closed in order that the battery current could act. This would give an unbalancing effect when signals are received, in addition to the rectifying of the oscillations, but there is no apparent need for rectifying at this point if two stages are used. The article states that a standard 22½ volt battery is to be used. This battery is known as a standard "B" battery and is composed of 15 small dry cells put up in one package.

M. C. I., Chicago, Ill.

Question: Will you kindly explain in words and diagram how to construct an inside aerial.

Answer: There are many forms of inside aerials and the construction of same will depend upon the available space. A very serviceable aerial can be made simply running one strand of ordinary bell wire around the room, placing it behind the moulding used for hanging pictures. Of course this should only be used where the room is above the first floor, as it will not be very efficient if it is not fairly high from the ground.

M. R. E. Co., Bedford, Ohio.

Question: In your first issue of Radio Age Magazine, on page 9, you say at the end of the article "Further information about Radiola will be furnished upon request." I wrote to you signing under the firm name asking for information about this, as I want to know if there are any patents on using, or making receiving sets in phonograph cabinets, also if you can advise me as to what is the best and loudest receiving hook-up on the market? If you can give me this information, it will be appreciated, as your magazine offers this upon request. I am a subscriber to your magazine under my personal name.

Answer: There are no patents covering the putting of radio apparatus in a phonograph cabinet, although most of the circuits used are patented. The particular circuit used in the Radiola is the regenerative type and uses the new Western Electric loud speaker. The ideal arrangement for an instrument of this kind is to use a circuit having three steps of radio frequency, detector, and two steps of audio amplification, for by using this system a small loop aerial may be placed inside the case, which will bring in stations located a thousand miles away. This circuit however, is also patented and can not be made and sold without first obtaining a license.

H. S. F., Chicago, Ill.

Question: I am constructing a crystal detector amplifier as described in the June number by Edwin Nielson. Could you kindly tell me how to make the amplifying transformer for same?

Answer: It is quite an undertaking to build an amplifying transformer unless full instructions are given. This would require too much space in this column, but in the near future this magazine will describe an amplifying transformer with all working drawings for same.

W. W. O., Chicago, Ill.

Question: I am a boy 12 years old and would like to know how to connect 3 audion bulbs together with the sockets for my radio apparatus and how to connect a test buzzer to a crystal set. Why can't you use iron contact points for a switch in radio? Can you use the 110 volt alternating current system for an aerial? Is there any way to make a crystal set stronger by adding some current? If so, explain how. I am greatly pleased with your Radio Age magazine, although I am not a subscriber, but expect to be very soon.

Answer: The circuit which you ask for is too large for this column, so I am sending it to you by mail. The test buzzer can be used by simply connecting it up just like an electric bell circuit; that is, so that when you press a button it will buzz, and the only connection necessary to the detector set is a wire connected from the moving armature of the buzzer to the ground wire of the detector set. Iron switch contacts are not practical for the reason that signals coming in to a receiving set are of a very high frequency and any iron material near any of the apparatus is very likely to have a choking effect upon these high frequency oscillations, which would tend to retard them and distort the signals. This is due to the magnetic properties of iron, and all metals used in radio apparatus should be non-magnetic for this reason. The 110 volt electric light system can be used for an aerial, but I do not advise it as it has not yet been passed upon by the Board of Fire Underwriters, and is quite dangerous unless the user is an experienced electrician. A crystal detector set can be amplified by using the standard two step amplifier, but this requires the use of amplifying bulbs, storage, and "B" batteries. An artcile in the June issue of this magazine gave a description of how a South American boy increased his signals by using additional crystal detectors, transformers and batteries, but as to how it will work out, I do not know, as I have not made a personal test of it.

Questions and Answers

This Department Conducted by FRANK D. PEARNE, Technical Editor of RADIO AGE and Chief Instructor in Electricity at Lane Technical High School, Chicago.

R. H. F., Chicago, Ill.

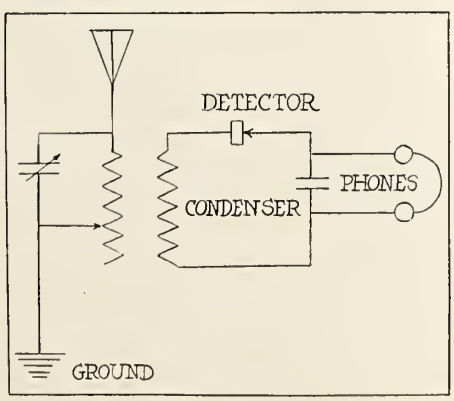
Question: In regard to the radio set in the Radio Age. I have made a set the same as the one you have in the paper and hooked it up the same as the copy, but I fail to get results. Can you give me any information in regard to the reason it does not work? I have a two-wire aerial nearly forty feet high and I can only get a buzzing sound. I bought a variable condenser, have changed crystals twice, still no results. I will be thankful for any information.

Answer: As a rule these sets give wonderful results, and I am inclined to think that in your case it is a matter of adjustment. Your aerial is high enough to give results, and if it is carefully insulated we can eliminate that. Go over all the connections and see that they are all soldered, making sure that where the loops are soldered to the switch contacts no wires are broken, and especially see that the loops are not broken, as this would leave part of the circuit open. If all the connections prove to be all right, and the set is made exactly as described, then it is nothing more than a poor adjustment of the crystal. If you have had no experience with crystals you will find that it requires a great deal of patience until you get familiar with the sound of a correctly adjusted detector. Look over the ground connection and try hooking your condenser across the aerial and ground.

V. C. D., Fort Dodge, Ia.

Question: Is there any way that I can use my loose coupler with an audion bulb detector? I am using a crystal detector with it now, and I have a Cunningham bulb and socket, but no variometers, and I want to know if I can use these without buying two variometers. Will I have to have a storage battery, or can I use dry cells on my bulb?

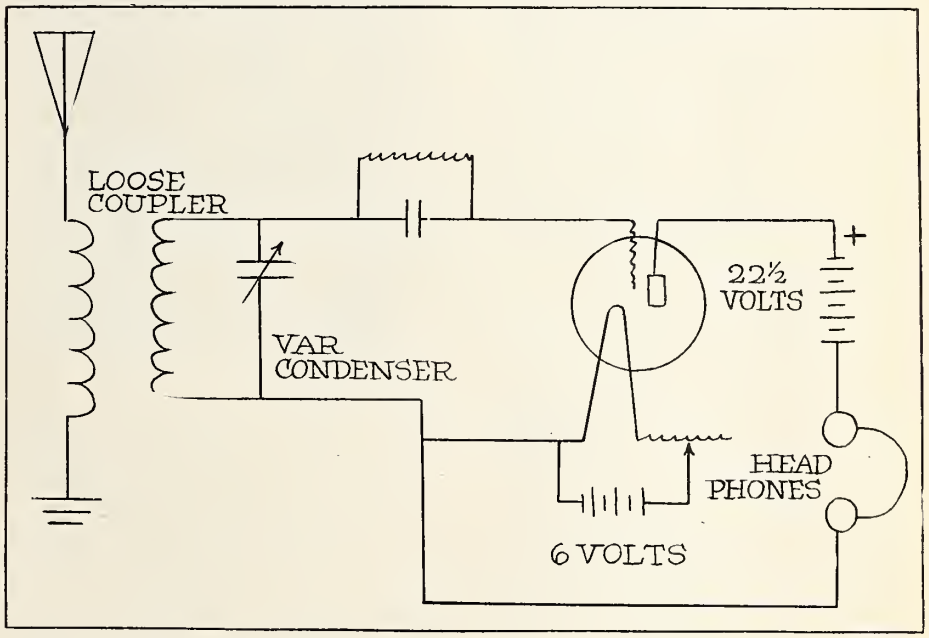
Answer: You can make up a fairly good set with a loose coupler and detector bulb if you will get a variable condenser to go with it. A 23-plate condenser should be large enough if there are not too many turns on the secondary of your coupler. You do not state the range in meters of your coupler. You will also have to have a rheostat for controlling the filament current on your bulb. A storage battery will be much more economical than the dry cells, as it will last much longer, and when it becomes discharged it can be charged up, while the dry cells will run for a very short time, when they will have to be disconnected and allowed to recuperate, and each time they are used they will run down faster, until they will have to be replaced by new cells. At best, they will give only a few hours' actual service and then you will have to buy four or five new cells. The storage battery will cost more, but the expense of recharging it once in a while is nothing compared to the cost of new dry cells every few days. The above hook-up will answer your purpose.



G. H. B., Kankakee, Ill.

Question: I want to find out what is meant by "radio frequency." I have a friend who says the best sets are radio frequency sets, but still he doesn't seem to be able to tell me what it is. Does it use a crystal or an audion detector? Please explain it to me, and any information you will give me will be appreciated very much. I get your paper every month and you can answer with the enclosed envelope, or through your paper.

Answer: Radio frequency is the term applied to those frequencies which are too high to be detected by the human ear, and those frequencies which are low enough to be heard are called "audio frequency." Usually currents which oscillate at less than 10,000 times per second are called audio frequency, and those which oscillate at a higher rate are called radio frequency. In order that radio frequencies may be heard they must first be changed to audio frequency. This is done by the detector, no matter whether it is a crystal or an audion. Radio signals are transmitted at radio frequency and changed to audio frequency by means of the detector.



R. E. B. Milwaukee, Wis.

Question: Is the enclosed circuit correct? If not will you please set me right and give me a hook-up that will work.

Answer: No. The variable condenser as you show it, is not connected to the right part of the circuit. Correct hook-up at left.

Radio at Culver

Students at Culver Military Academy have an unusual opportunity not only to learn the technical side of wireless, but to engage personally in the work of sending messages and what is more valuable from an educational standpoint, in making apparatus. The following description of the wireless station of Culver was prepared by a cadet operator, Homer M. Barnes, of Chicago, Illinois, a young student, fifteen years of age.

New aerials have been erected during the past year. The old type aerial, an inverted L, was done away with and a six wire fan erected in its place. This fan aerial gave us more radiation and extended our receiving range. The supporting cable of the fan is 95 feet above the ground, and supported by two masts which are made of angle iron. These towers are grounded to the iron frame of the building. The six wires, which constitute the aerial proper, are each 70 feet in length. The fundamental wave length of this aerial is 255 meters.

The receiving equipment consists of two distinct sets. One, a short wave regenerative for 175-600 meters, and the other a long wave set with a range of 325-18,000 meters with a heterdyne oscillatory circuit for receiving undamped traffic. One type S. C. R. 72 two stage amplifier is used alone in connection with a type AC 3 model C magnavox power amplifier and a R 2 18 inch horn. There are several S. C. R. 54 portable field sets, which are used in the field.

Radio concerts are heard here regularly, and with enough volume and clearness to permit the use of twenty pairs of phones. Some of the broadcasting stations heard here are WGY, WJZ, KYW, KDKA, WWJ, WCX, WOH, and others. The radio room is filled with cadets wanting to hear the latest popular pieces played by the famous jazz orchestras.

The main transmitting set is a 2 K. W. 240 cycle Marconi Marine set with a synchronous rotary gap with a fully equipped switchboard as shown in the illustration. The motor generator delivers 500 V. A. C. The maximum transformer input is 2 K. W. which is always varied according to the distance over which we are communicating. The maximum antenna current is 9½ amperes or 375 meters. The high tension condenser bank is made up of 12 Leyden jars connected in series parallel, having a total capacity of .009 mfds, in order not to put too much strain on the jars.

Radio Roster at Chicago Show

The many exhibitors at the National Radio Exposition, held in the Leiter Building, Chicago, from June 26 to July 1st were a live bunch of enthusiastic, hard-working, level-headed radio men. Any doubting Thomas who needed evidence to convince him that radio is here to stay had only to visit this show and absorb some of the forward-moving spirit of it. Herewith we publish a list of firms occupying booths and names of their representatives.

Jefferson Electric Mfg. Co., 426 So. Green St., Chicago. R. Benson in charge.

Electric Service Products Co., 10-12 So. Wells St.

Great Lakes Naval Radio School. F. A. Mueller, chief Electrician's Mate U. S. Navy.

Indiana Electrical Specialty Co., Martinsville, Ind.

Aerex Radiophone Corp., 342 Madison Ave., N. Y.

Taylor Saver Sales, 3500 Greenview Ave., City.

W. G. Shinn Mfg. Co., L. H. Greenwood, N. W. Caldwell, G. L. McCall.

Lyon & Healy, Chas P. Hindringer.

North Shore Radio Co., 810 Davis St., T. B. Wangeman.

Continental Radiophone Co., 45th and So. Wells St., Otto Henderer, Wm. Sabatay.

Schreuder-Lockwood Press Syndicate, 64 W. Randolph St., A. N. Schreuder, W. C. Lockwood, F. L. Bollinger, C. W. Hanika, W. J. Carroll.

The Barkelew Elect. Mfg. Co. C. W. Denny.

The Heinemann Elect. Co. B. S. Berlin, S. R. Fralick & Co., 15 So. Clinton, Mr. S. R. Fralick, Mr. D. J. Dillon.

The Davistone Co. Harold I. Orwig, Miles S. Whitney,, Mr. McCrillus, Harry B. Davis.

Post Electric Co. Richard Allen.

Maring Wire Co., Muskegon, Mich., F. L. Meeske, pres. H. Simpson, Chicago rep., 27 So. Desplaines St.

The A. & R. Co. Mr. Shirk, Mr. Stoller.

Ayan Jay Sales Co. N. Afton, C. F. Mayer, H. H. Jonesi, Miss Thyra Strandberg, J. F. Mayer.

Cruver Mfg. Co. William Proudfoot. L. S. Branch Mfg. Co., Newark.

American Electric, 6431 State St. P. L. Rose.

United Mfg. & Distributing Co. A. E. Dreier.

The Benson Co., 2429 So. Michigan Blvd.

Commonwealth Edison Co. A. W. Inglis, Dave Miller, R. E. Davis, H. Randol, J. Marshall, Geo. B. Foster.

Hercules Radio Corp. E. B. Miller, Chas. C. Gordon, H. J. Birmingham, Ben. E. Freund.

States Radio Corp. Anatol Gallos, Norman Gallos, J. E. Marshall, J. M. Hays, J. W. Juff, S. Owens, F. L. Damarin.

W. O. Duntley & Co., A. Fasking, S. Fasking, H. J. Theil, W. O. Duntley, C. A. Duntley.

Dodge's Radio Institute, Valparaiso, Ind.

Chicago Radio Dealers, Inc.

Western Electric Instrument Co., Newark, N. J. H. C. Sildorff.

The Bristol Co., Waterbury, Conn. H. G. Hall, M. J. Maquire, R. C. Wilcox.

Wireless Corp. of America, E. S. Showers, L. Mandel, H. Mandel.

M. & M. Mfg. Co., 7447 So. Chicago Ave. A. C. McMillen.

Hipwell Mfg. Co., Pittsburgh. F. M. Weaver, in charge.

The Beckley-Ralston Co., 1801 So. Michigan Ave. W. A. Bockius.

Norbert Radio Co., New York. Wm. G. Moyer.

Drisco Mfg. Co. Harold M. Schwab, Inc.

Philadelphia Storage Battery Co. J. N. North, G. M. Netling, E. W. Shepherd, E. H. Stupp, H. W. Stoltz.

Ray-Di-Co. Organization, Inc., 1547 N. Wells St., 1215 Leland Ave., Chicago. R. O. Ragan in charge.

Raymond Radio Cor. H. Schwartz in charge.

Radio Club of Illinois. John Tansey, Secy.

Westphal Mfg. Laboratory, Railway Exchange Bldg., Chicago.

Radio Digest, Illustrated. E. C. Rayner.

Electric Research Laboratories (Erea Products).

Marshall P. Fox, 2515 Michigan Ave.

Washburn School. M. Georges.

Coliseum Battery Co., 1841 So. Wabash Ave. R. E. Harte.

Raymond Condensers, 914 Wrigley Bldg.

Herald & Examiner, Victor Crystal Receivers, demonstarted by Prof. Edward L. Taylor and Prof. C. O. Nelson of the Examiner.

The Nash—Odell Co. I. J. Odell, C. A. Nash, R. J. Weston, K. A. Everett, H. J. Pomy, Mr. Strohbart, C. W. Jones, U. S. Radio Inspector, 172 N. Franklin St., Chicago.

Chicago Radio Co., 123 Madison St. J. F. Palmer, Bert Barsook.

United Radio Laboratories, Cincinnati, Ohio. Paul P. Ewing, E. W. Wesselman.

Radio Sales & Service Corp., 1311 First Nat'l Bank Bldg, City. M. Ferry, N. J. Dowdell, Hoppock.

Darche Mfg. Co., 643 Washington Blvd., City. E. J. Heilman, C. H. Holden.

Ampli-Radio Co., 1438 Washington Blvd. Earl L. Smith.

The General Phonograph Mfg. Co., Elyria, O. Homer Stevens, Dan F. Lane, R. G. Sidnell.

Morscan Radio Co. Eugene Scanlon, P. D. Jackson.

Crosley Mfg. Co., Cincinnati, O.

Jewett Mfg. Co., Newark, N. J. C. C. Goheen.

Widdicomb Furniture Co. (Radio Cabinets) 327 So. La Salle St. W. E. Ernst.

Atlas Radio Co., 405 Woods Theatre Bldg. M. M. Jess.

Universal Battery Co. C. R. Story, L. L. Cochran.

American Enameled Magnet Wire Co., Muskegon, Mich. Thomas F. Kelly.

American Radio Journal. A. Foster George.

Electric Machine Corp., Indianapolis, Ind. B. F. Royse.

Radio Units, Inc., 843 Webster Bldg., City. E. F. Andrews, Frank W. Johnson, R. E. Acre.

Coyne Trade & Engineering School, 39-51 E. Illinois St., City. E. L. Richards.

The Ekko Company, 911 Harris Trust Co. H. E. Freund (Phonograph Adapters).

Development of Radiophone Broadcasting

L. R. KRUMM, Superintendent of Radio Operations of the Westinghouse Electric & Manufacturing Company, is one of the best informed men on wireless of the present day. Mr. Krumm served as Lieutenant Colonel, Signal Corps of the A. E. F.; was 18 months in France on the staff of the Chief Signal Officer, Gen. Edgar Russell; and had charge of all radio operations of the A. E. F. For his service during the War he was awarded the Distinguished Service Medal by the United States, and the Legion D'Honneur by France. Mr. Krumm came to the Westinghouse Company from the army. Previous to his army service he was Chief Radio Inspector of the Bureau of Navigation, Department of Commerce.

ON FEBRUARY 27 of this year there was held in Washington an open hearing before a committee of radio engineers, military officers and government representatives, appointed by the Secretary of Commerce to formulate proposed laws and regulations to meet the new radio conditions which have developed since the termination of the war. Nearly two hundred representatives of various commercial, amateur and governmental radio interests attended this conference. The large number of reporters, photographers and moving picture operators in attendance also indicated the great public interest in this meeting.

What caused this sudden interest in new radio legislation? There have been no radical changes in the radio art as applied to international communication between the high powered stations in this country and those in foreign lands. Neither have there been any particular changes in radio communication between ships and between ships and shore stations. There have been some developments in radio telephone communication between ships and airplane and ground stations and in regard to locating ships at sea by means of radio and even some advance in communicating with submarines while submerged, but these were not the answer to our question.

$75,000,000 Invested in Radio

The main purpose of this conference was to devise means to meet the problems which had arisen through the establishment of the radio telephone broadcasting stations which are sending out news, live stock and grain reports, weather forecasts, sermons, speeches and entertainment and which have caused the installation during the last year

H. P. Davis

and a half of anywhere from 700,000 to 1,000,000 radio receiving stations, representing a probable expenditure of approximately $75,000,000.

Previous to the establishment of broadcasting stations working on absolutely dependable schedules, the public's interest in radio had been limited to the technically inclined amateur operators with some knowledge of the electrical principles involved in radio telegraph communication. These men were dyed in the wool faddists on radio. They wanted to know what "made the wheels go round" and how to make them go. They wanted to establish radio telegraph transmitting stations. For this, it was necessary to study the Continental Morse code and secure operators' licenses from the government. All this they did in addition to investing considerable money and time in the purchase and installation of the equipment.

It was estimated before the World War that there were some 6,000 licensed amateur transmitting stations and probably 50,000 receiving stations which required no license. All these were closed during the war. The amateur receiving stations were allowed to reopen April 15, 1919. On October 1, 1919, amateur transmitting stations were allowed to operate again. The amateur radio activities had languished during the war period and probably there were fewer amateur stations after than before the war.

Mr. Conrad's Great Service

During the war, Mr. Frank Conrad, Assistant Electrical Engineer for the Westinghouse Electric & Manufacturing Company, had become interested in radio work because he had given his best efforts to assist the government in producing the very highest type of radio equipment for the army and navy. Practically the only type of equipment which was produced in quantity and delivered in France in time to be of any service to the American troops and which met the requirements of warfare was an airplane transmitter known as SCR-73 set, developed and produced by this company and its subsidiaries. Mr. Conrad's activities covered, however, more than this equipment, as he was also interested in the development of various types of radio telephone sets. To aid him in his experiments he was given a special license to operate during the war a radio telephone at his home at Pittsburgh, Pa.

After the armistice he retained his interests in his work and, operating under this special license was able to continue development of his radio telephone station to a degree of success exceeding anything heretofore attained. The Westinghouse Company, which, previous to the war, had no radio interests, also decided that a company of its magnitude could no longer exclude radio from its activities and had entered this branch of the electrical business. It was intensely interested in Mr. Conrad's researches and he continued his work with its encouragement and assistance.

In the winter of 1919 Mr. Conrad established at his residence in Pittsburgh, Pa., a radio telephone broadcasting station and began the regular broadcasting of music and entertainment. This station was then known as 8XK, the call letters assigned in the new license he carried from the Department of Commerce. At first his efforts were confined to the broadcasting of phonograph music every Wednesday and Friday night. Soon his supply of records was exhausted and one night, in response to many letters requesting the latest popular music, he an-

nounced that he had exhausted his records and was financially embarrassed trying to keep up with the demand for newer music and suggested that possibly his hearers would like to help him out in this dilemma. He was the recipient of nearly 500 records. The magnitude of the response to this appeal indicated the appreciation of his audience and the demand for its continuance.

Music Transmitted Direct

He broadened his activities by providing a studio in which artists, instrumental and vocal, could render selections for transmission from his radio station, a short distance away.

Mr. H. P. Davis, Vice President of the Westinghouse Electric & Manufacturing Company, who was largely responsible for his company entering the radio field, had been watching not only the technical development of the equipment but also the attitude of the public towards broadcasting, realized the necessity of providing this service in a systematic and properly organized manner as a part of his company's business operations, and, therefore, in the fall of 1920, began the construction of a broadcasting station at the East Pittsburgh plant.

Experiments were carried on for several weeks previous to election night in November, 1920, when it was intended to inaugurate this service by broadcasting the election returns. A special license was obtained from the government radio inspector in Detroit, Mich., and the call letters 8ZZ were assigned to the station in the beginning.

The election results were startlingly satisfactory and the letters of appreciation received by the company dispersed any doubts as to the advisability of continuing broadcasting. Plans for the improvement and enlargement of the station were immediately inaugurated and regular nightly programs were announced with specially selected artists as entertainers. A wave length of 330 meters was originally assigned to this station.

It was immediately evident that suitable programs must be provided for Sundays, as the ordinary entertainment did not seem appropriate. This naturally resulted in the desire to broadcast church services, but this required additional technical development, as it was desired to transmit the complete service from the chimes to the postlude. It was therefore necessary to devise equipment which could be installed in the church, pick up the choir and congregational singing, the sermon and oral parts of the service and amplify them sufficiently so that they could be transmitted over the telpehone line without distortion. Remember, this required transmission over thirteen miles of telephone line and cable. The acoustics of most churches leave much to be desired and this line transmitting was no simple problem.

Radio in the War

Much was printed during the war regarding the radio telephone developments for our fighting forces. While many interesting developments resulted and some fundamental principles founded there was very little practical application of radio telephony during the war, and practically none by the fighting forces. In the development work Mr. Conrad had been an active participant and he began his broadcasting work with this war experience as a basis and used the personnel and manufacturing facilities of the Westinghouse Electric & Manufacturing Company.

When the company took up broadcasting actively they immediately provided the necessary funds to develop it to the utmost. It is not exaggeration to state that their station at East Pittsburgh, now known as KDKA, the matured successor of 8ZZ, has never been more than one week old in the sense that better and improved forms of equipment are continuously being provided. KDKA may, therefore, be called the father of the broadcasting activities in this country today.

It is true that radio telephone broadcasting had been attempted spasmodically even previous to the war. Various experimenters had sent out music from their stations in the course of their efforts to develop radio telephony. These experiments had been with varying results as to quality and were never maintained with any regularity or dependability so that the war found this country without any commercial or reliable radio telephony. Wartime developments indicated the possibilities which the coming of peace made realities. During the war all commercial radio activities were suspended by government decree. The development of KDKA since that time has just been followed.

After KDKA had been operated for nearly a year and its practicability demonstrated the Westinghouse Company proceeded to establish additional stations at their branch factories at Newark, N. J., and East Springfield, Mass. These were opened in the fall of 1921. With the establishment of the additional stations the Department of Commerce had assigned a wave length of 360 meters to all the Westinghouse Stations.

On November 11, 1921, Armistice Day, an anniversary of the war, which in a way was the father of broadcasting, the Westinghouse Company opened its broadcasting station located on the Commonwealth Edison Building at Chicago, Illinois. This station was opened by arrangement with the Chicago Edison Company, who desired to open it with the broadcasting of complete grand opera from the Auditorium Theatre, Chicago, which started its season the following Monday, November 14, 1921.

This, as far as the writer knows, was the first case in which complete grand opera from the overture at the beginning to the final chorus was sent out by radio telephone.

Each of the Westinghouse stations cover a different section of the country, but each has been successful in arousing great interest and causing the installation of innumerable receiving stations.

Confusion in Broadcasting

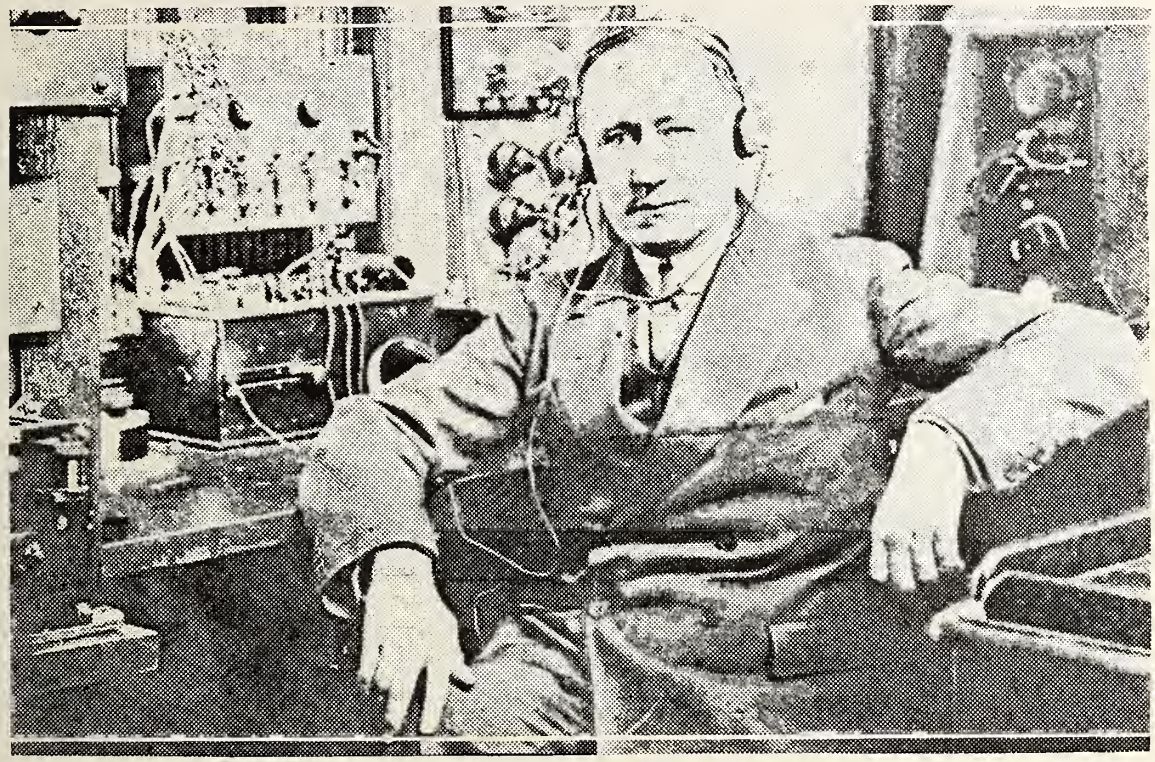
Other business interests established broadcasting stations each of which was assigned to the 360 meter wave length.

The operation of all these stations on the wave length originally assigned the Westinghouse stations had brought up a chaotic condition in the ether which brought about the conference referred to in the beginning of this article.

It was evident that provision must be made to assign different wave lengths to the various stations which must be classified as to range and purpose and that limitations must be imposed as to schedule, power and area of activity. The enormous publicity given the Westinghouse Company because of its pioneer activities attracted the attention of many firms who desired to do likewise, without a realization of the time and money expended or that the greatest expense of the proper operation of such a station is the facilities necessary for the improvement and development of the equipment, such as are usually only available to a company interested in the manufacture of radio equipment. Secretary Hoover of the Department of Commerce recognized that unrestricted establishment of broadcasting stations would result in bedlam and therefore inaugurated the movement which resulted in the commit-

(Continued on page 32)

Marconi Describes Radio Searchlight



Senatore Marconi is in this country for a visit, having sailed from Italy on his yacht "Electra," which is the most elaborately equipped floating radio laboratory in the world. Read what Senatore Marconi has to say about amazing "radio searchlight"

THE radio searchlight, a method by which radio waves transmitted from a broadcasting station can be reflected in any desired direction, just as light rays are directed from a searchlight, was announced by Senatore Guglielmo Marconi in his address before a joint meeting of the Institute of Radio Engineers and the American Institute of Electrical Engineers in New York, Tuesday night, June 20.

At present radio waves, upon leaving the antenna, scatter in all directions. His apparatus, which in no way resembles a searchlight but is a series of wires arranged in a special way on towers or masts, sends the message through the ether in one direction only, Marconi said. He amplified his words by a demonstration in the hall. Messages transmitted were picked up clearly on one side of the room but could scarcely be heard with similar receiving apparatus on the other, and vice versa.

With his system of reflectors, Marconi stated that he had successfully conducted radio telephone conversations between London and Birmingham, a distance of 100 miles. This is a record in long distance radio transmission and reception with very short waves. In all these experiments the wavelength varied from one to twenty meters.

The reflectors make it possible for the receiving station to reproduce a telephone song or speech about two hundred times louder than is now possible and without distortion. The transmitting aerial can be used both for transmitting and receiving at the same time.

"In these days of broadcasting, it may still prove to be very useful to have a practically new system which would be to a very large degree secret when compared to the usual kind of radio," said Marconi.

The Radio Beacon

Marconi described a revolving transmitter and reflector which acts as a kind of wireless lighthouse or beacon. "By means of the revolving beam," he stated, "it is possible for ships to ascertain in thick weather the bearing and position of the lighthouse."

In wireless, electric energy is flashed into space in waves. The distance from one wave crest to another is called "the wave-length" and is usually expressed in meters. In these days, when radio is the hobby of millions, the wave-length may be anything from 200 to 20,000 meters. In other words, the ether of space is shaken into terrific billows compared with which the mightiest upheavals of the ocean are mere ripples.

"As far back as 1895 and 1896, I had obtained some promising results with waves not more than a few inches long," said Marconi. He then proceeded to describe how he had returned to his original idea of using short waves.

Marconi stated that when very short waves are used, disturbances caused by static can be said to be almost non-existent and the only interference comes from the ignition apparatus of automobiles and motorboats. He predicted that, " the day may come when we will have to screen our ignition systems or carry a government license for transmitting."

Radio Around the Earth

"The question as to whether it would be possible to transmit radio signals right around the world is one which has always fascinated me," Marconi assured his hearers. He discovered that "there is something in the idea of the wireless waves traveling around the earth in

various ways and reuniting at the Antipodes." Sometimes these radio waves traveling around the earth in different ways reenforce each other at the receiver and sometimes they interfere with each other. Tuning, however, overcomes the interference. The enormous station built by the Radio Corporation of America at Port Jefferson, Long Island, Marconi found, sent waves which "preferred to travel three-quarters of the way around the earth rather than come the shortest way round."

Static, a subject to which the research engineers of the Radio Corporation of America have devoted much study in this country, was also discussed by Marconi. He told his hearers that there are particularly violent types of static over Africa and South America, but that static did not interfere very seriously in transoceanic commmunication in temperate zones.

Senatore Marconi is visiting this country for the first time in a decade as guest of the Radio Corporation of America.

For Radio Amateurs

Among the books received for review during the past month is "Radio for the Amateur" published by The Goodheart-Willcox Company, 2009 South Michigan avenue, Chicago. It is a book of 208 pages by A. H. Packer and R. R. Haugh ($1.50 postpaid).

It's a good book because it is original, and because every word in it can be easily understood. It does not reproduce formerly published material. It is written with clear-sighted originality and with a human appreciation of the fact that there are some things that the amateur does not want to know about, and does not need to be puzzled over, but that there are certain basic principles that he must understand if he is to understand what he is doing when he is playing with "radio."

Russell Productions, Inc., already famous for their "little picture" demonstrating the "how" of making a radio receiving set for 60 cents, will come back with an immense production called "Saved By Radio"—the biggest and most timely feature of the year starring George Larkin in whose support will appear such well known stars as Jacqueline Logan, Harry Northrup and Andrew Arbuckle.

(Continued from Page 12)

reverse the potential to 2 volts positive, then the current in the plate circuit will have changed from 2 micro amperes to 40 micro amperes, which would be the practical limit of change in that particular tube. From this chart it will be seen how, with

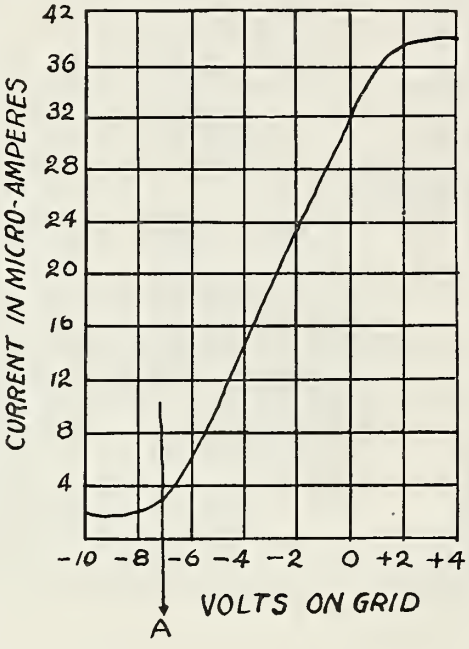


FIGURE 4.

extremely small changes in the grid circuit, very large changes will take place in the plate circuit and the signals are amplified many times in the head phones.

Vacuum Tube as an Oscillator

If a proper coupling is made between the plate and grid circuits, continuous oscillations may be produced with the valve.

Figure 5 shows a circuit of this kind, in which the inductance "L" in the grid circuit and the inductance "L1" of the plate circuit are coupled together in such a way that any change in the current in "L1" will produce a voltage in "L." Now assume that the filament is heated and a steady current of a certain value is flowing in the plate circuit, through the inductance "L1." Now any change in the current flowing through the inductance "L1" will induce a voltage in the coil "L." If the coil "L" is connected so that increasing the current in "L1" induces a voltage in "L" of such a value as to charge the grid positive with respect to the filament, a greater increase will take place in the current in the coil "L1." This will increase the positive charge on the grid still more, by induction and so on. This action continues until it reaches a point where an increase in voltage on the grid ceases to cause an increase in the current in the coil "L1." This point depends upon the characteristic curve of the particular bulb used and the resistance of the circuit. When the current in the coil "L1" ceases to increase the charge on the grid drops to zero and the current in "L1" begins to decrease. Now if an increase in the current in "L1" gives the grid a positive charge by inductive action, then a decrease in it will make it negative in respect to the filament, which will cause the current in "L1" to decrease to a point where a decrease in the grid potential causes no further decrease in the current in the coil "L1," when the conditions will be reversed and the current in "L1" will begin to rise again, repeating the cycle just described. By this means the plate current is made to rise and fall with a definite frequency. This frequency will depend upon the inductance "L" and the condenser "C." It is possible, by properly choosing the inductance and capacity, to produce oscillations in such a circuit ranging from .5 to 100,000,000 cycles per second. This is a description of only one of the many oscillating circuits.

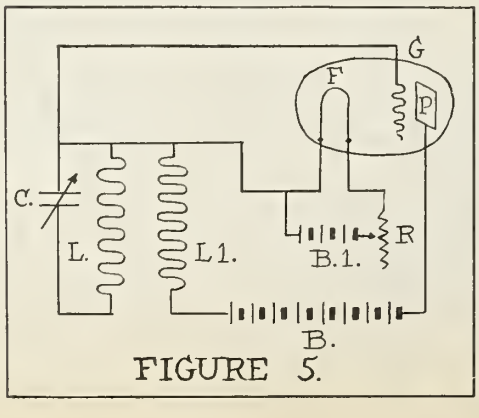


FIGURE 5.

KDKA, the radiophone broadcasting station of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., first station in the world to broadcast concerts on a schedule basis is the first of the American radiophone stations to be heard south of the Equator, having been picked up by a ship operator while in the port of Iquique, Chile.

Solder Your Connections
for best results. Get the **"Wonder" a Self Heating Iron.** Use it anywhere without stove. No workshop complete without it. Cheap to operate. Generates own vapor in two minutes. Absolutely safe — a child can operate. Nothing to get out of order. Use it as a blow torch also. Boxed complete with solder, salamoniac and full soldering directions. **Send No Money**— just your name and address on a post card. When the postman delivers, pay him $2.50.
Dealers—a big seller, write for proposition.
North Shore Radio Works, Dept. B-604
810 Davis Street, Evanston, Ill.

Market and Crop News by Uncle Sam's Radio

Official Information Supplied by the Government Bureau

THE radio market news service of the Federal Bureau of Markets and Crop Estimates is an effort on the part of the Bureau to make its market news more immediately available and more effective than it can be made in any other way. Ever since the inauguration of the first market news service on fruits and vegetables in May, 1915, the specialists of the Bureau have given continuous study to the problem of supplying market news on agricultural commodities to those cooperates with all agencies poswho may have use for such information as quickly as possible after it can be obtained.

The market news service of the Bureau cover live stock and meats; dairy and poultry products; fruits and vegetables; hay, feed and seeds, and some other commodities associated with these four general groups. The information is supplied to and is utilized by producers, shippers, dealers, brokers and commission men, manufacturers, warehousemen, demonstration and extension workers, banks, transportation agencies, chambers of commerce, buying and selling organizations, and other commercial, extension and education agencies.

It is the function of the Bureau to gather or assemble market information from reliable sources and distribute it in such a way as to make it available to the greatest possible number who wish to use it. In performing this function it utilizes and cooperates with all agencies possible. It affiliates with State agencies which may or may not have similar functions with respect to the State as the Federal Bureau of Markets and Crop Estimates has to the Federal Government. It utilizes the railroads for information relative to shipments and movements. In one way or another, it assembles information from every available source where such information can be obtained.

Broadcasting by Radio

In utilizing radio communication as a means of disseminating crop and market information, the Bureau of Markets and Crop Estimates is taking advantage of one of the agencies which has certain possibilities possessed by none that has been used in the past. This new method

COMPLYING with a special request from the Editor of Radio Age, Mr. W. R. Wheeler, of the U. S. Bureau of Markets and Crop Estimates, has supplied the following information which will be of universal interest and of particular interest to all lines of business associated with agriculture, grain and produce exchanges, transportation agencies, warehousemen and banks.

makes it possible for all who wish this information to help themselves to it, if they will but equip themselves to receive it in the form in which it is sent. The advantages of broadcasting information by radio are (1) that the information can be intercepted or copied by means of suitable equipment at any point within certain approximate limits whether or not such point is connected by railroad, telegraph or any other of the ordinary means of communication and (2) that the transmission of the news is instantaneous.

These two factors in radio communication make it possible for anyone, whether he is located in a congested city or in the country, one hundred miles from the railroad or telegraph wire to receive information with equal dispatch. Radio transmission can be effected either by the international telegraph code, using dots and dashes, or by radio telephone. The radio telephone has the greatest possible range of usefulness and will probably become almost as widely used as the ordinary telephone or the phonograph.

Reception of Reports

Crop and market reports sent out broadcast by radio can be received by any agency having suitable equipment. With the development of broadcasting by radiophone there has developed a demand for receiving equipment from many sources. Not much greater technical knowledge is required to receive the report by radiophone than to use an ordinary telephone.

The broadcast reports are being utilized by various marketing agencies and agricultural organizations in giving to farmers national crop and market reports which are often combined with local market information. These agencies and associations act as centers for information for the country or locality and include farm bureaus, banks, shipping associations, commercial exchanges, chambers of commerce and newspapers. In addition to these agencies the reports are being received direct by farmers, country elevators, dealers, shippers and many others who use the information in the conduct of their business. In some instances it may be to the advantage of the community or to individuals or an organization to enlist the aid of a local radio amateur to get the news and the weather, crop and market reports.

How Service Developed

Since the radio market news service was begun experimentally by the Federal Bureau of Markets, on Dec. 15, 1920 it has developed very rapidly so that, at the present time the national market news is not only being distributed by the Bureau but other agencies are extending the distribution of the national crop and market reports as well as local reports. The reports originally were sent out at 5 p. m. each day from the station of the Bureau of Standards, through the co-operation of the U. S. Department of Commerce.

This was continued for four months to determine the practicability of the method.

When it became apparent that this method would not only be practicable but also more economical and efficient for certain kinds of distribution than any other agencies, the Bureau of Markets accepted the offer of the Post Office Department to utilize the radio stations of the air mail radio service in the dissemination of crop and market reports.

At the present time the air mail radio service is broadcasting the crop and market reports from six of its stations. Of these six stations, two of them, Washington, D. C., and Omaha, Neb., procure their information directly from the Bureau of Markets and Crop Estimates offices. The others, extending at about 350 miles intervals west from Omaha to the Pacific Coast, act as relay stations for the Omaha report.

Many of the universities and agricultural colleges giving instruction in radio communication in connection with their departments of physics or electrical engineering, have set up programs of broadcasting

either alone or in cooperation with the State marketing agencies. This work began with the dissemination of weather reports from the Kansas State Agricultural College in 1916. Crop and market reports are now being broadcast from several universities and colleges. The number of stations broadcasting the weather, crop and market reports is increasing almost daily. The additions to this list can be secured by addressing the Radio News Service of the Bureau of Markets and Crop Estimates, Washington, D. C.

Leased Wires Inadequate

The leased wire service of the Bureau of Markets and Crop Estimates was established in 1916 and during the past six years as many as 17,600 miles of leased wire and 61 branch offices have been in operation. The leased wire has been used to carry reports from the markets, shipment information and reports from shipping points as to supply, demand, and f.o.b. prices. Even in its most extended form, the leased wire with the largest number of branch offices was never able to reach more than a small percentage of the people interested.

The function of the leased wire will not be changed or curtailed by the establishment of the radio method but will be the nucleus of an effective system employing wired telegraph and telephone as well as radio telegraph and telephone, and may be extended.

The Air Mail Radio Service of the Post Office Department was established primarily to give communication between the flying fields, in connection with the transportation of mail by airplanes. These stations have to be available for service a large part of the day but have considerable time which is not necessarily occupied in the business of the air mail service. The market reports are sent out on schedules which are adapted to the unoccupied time at the stations.

Forms of Reports

Certain types of market information can be put into a form for rapid transmission by use of standard forms and code letters. This does not involve the ordinary use of code words and the necessity of coding and decoding the messages received but it does make necessary the sending and receiving of messages on a special form. Inasmuch as the sender and receiver use identical forms it is possible by the use of the code letters preceding each blank space in which information is to be copied to transmit rapidly a large amount of information prepared in standardized form. By use of such special forms and regular transmitting schedules a very effective service can be developed. This field has only been touched upon and great improvements undoubtedly will be developed in the handling of information in this way by both radio telephone and radio telegraph.

Cooperation with States

In a number of States, the State bureaus of markets and State extension departments, are cooperating with the Federal Bureau of Markets and Crop Estimates in organizing the agricultural communities to receive and utilize radio crop and market reports. In some cases they have established information centers which serve as distribution points for sending out the information through various channels. In some cases progressive agricultural counties have installed receiving equipment in connection with farmers' organizations so that the information will be available to the county agent for further extension either through the daily newspapers, telephone exchanges, or other agencies. It is probable that an important application of the radio service will be through organizations or institutions which will install equipment with competent operators to receive the reports and distribute them or make them available to individuals or groups or organizations of producers. Since the radiophone is coming into more general use, many of those engaged in producing or marketing farm products are installing equipment to receive the reports directly as no special trained operator is necessary to operate the equipment.

The State marketing agencies that have either made installations of equipment or arranged for broadcasting are:

New Jersey Bureau of Markets, Trenton, N. J.

The Alabama Markets Division, Montgomery, Ala.

Iowa Agricultural Extension Service, Iowa State College, Ames, Iowa.

Minnesota Division of Markets, St. Paul, Minn.

Missouri State Marketing Bureau Jefferson City, Mo.

Nebraska Bureau of Markets & Marketing, Lincoln, Neb.

New York State Division Foods & Markets, Albany, N. Y.

Ohio Division of Markets, Columbus, Ohio.

Pennsylvania Bureau of Markets, Harrisburg, Pa.

Texas Division of Markets and Warehouse Dept., Austin, Tex.

Texas Bureau of Markets, Dept. of Agric., Austin, Texas.

Wisconsin Department of Markets, Madison, Wis.

Massachusetts Division of Markets, Boston, Mass.

Colorado Division of Marketing and College of Agriculture Cooperating, Ft. Collins, Colo.

Arrangements in other States are under consideration.

How to Make a Home Radio Set

To cost from $6.00 to $20.00. Contains complete instructions for the construction of a practical home receiving station at small cost.

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Price 25c post paid

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RADIO AGE, *Circulation Department*, 64 West Randolph Street, CHICAGO

NAME..... STREET.....

CITY..... STATE.....

Radio News from Coast to Coast

ALABAMA

Farmers of Alabama and adjoining states are getting daily market, crop and weather reports from the broadcasting station of the Alabama Power Co., of Birmingham.

ARKANSAS

Invitations to the Police Chiefs convention in San Francisco were sent broadcast by radio and a keen rivalry resulted in Fort Smith, as elsewhere, among amateurs seeking to first receive and deliver the messages to their local chiefs.

CALIFORNIA

Bus passengers in Oakland are entertainment on their way to and from work by radio programs.

Walter Brinkop, Republican candidate for state treasurer, used radio transmission to broadcast his speeches.

COLORADO

A radiophone address was made from an airplane by Secretary of State Carl S. Milliken.

ILLINOIS

Among the many radio tourists who have passed through Chicago is Wallace Blood, of Detroit, bound for San Francisco with full radiophone equipment in his sedan car.

Foreign exchange and Chicago stock market quotations are broadcast daily.

Thieves stole the radio set from the Friendship Center church. It was valued at $250.

One hundred and fifty men were enlisted in the radio branch of the Illinois National Guard which went into camp at Camp Grant on July 17th. The outfit is known as the 33rd Signal Co.

The Rev. George Craig Stewart, St. Luke's Episcopal Church, Evanston, said radio might assist in religious work but it would not interfere with church work nor supplant it.

W. K. McIver, of Elgin, has a receiving set with which he can pick up Schenectady, Indianapolis, Detroit, Chicago, Kansas City and Madison. He has even heard San Francisco. He says he has definitely identified more than sixty broadcasting stations and he attributes his success to his own "Elgin Spider" tuning coil.

Lawrence B. Schmitt, for more than a year and a half inspector of the Ninth radio district, with headquarters in Chicago, has resigned to open a Chicago office for the Ship Owners' Radio Service, Inc., of New York. E. A. Beane, formerly inspector with headquarters in New York, succeeded Mr. Schmitt.

Belleville, with upwards of 80 receiving sets, has organized a radio club.

Naval radio compass stations have been opened at Whitefish Point, Detour Point and Grand Marais, Mich. The U. S. naval communication service will furnish lake vessels with their bearings. The stations were built and are operated under the supervision of Capt. Waldo Evans, Ninth naval district.

IOWA

The Ames Times warns its readers against permitting aerials to come in contact with electric light wires. Do you remember the old story of the old maid who sat by a river and wept distressingly. When they asked her why she wept, she said, "I was thinking what if I should get married and have two children and they should both fall in this river and drown."

INDIANA

An electrical baking apparatus was manipulated by radio at Muncie's annual pure food show. And it was good bread.

The Rochester Radio Co. is receiving and distributing market reports from Chicago, Indianapolis, Peru and Rochester, in co-operation with the Rochester Sun.

KENTUCKY

Walter Shackleton of the Krausgill Piano Co., Louisville, attached his aerial lead wire to the bars of the cashier's cage. Result: radio music and everything. Anybody who can get anything out of a cashier's cage these days is going some.

LOUISIANA

The lighting mains of the city of New Orleans have been successfully used as a radio telephone receiving antenna by G. Kerley, chief electrician of the Uneedme Service Company on Camp street.

MICHIGAN

The state department of public safety contemplates using radio for automobiles and motorcycles of the state police. If experiments are successful six large stations will be erected.

William J. O'Brien was the first to equip his canoe at Belle Isle with radio.

Joseph Gerou, admiral of the Elks' cruise had the craft equipped with radio by which the cruisers received daily programs from the Detroit News station.

Passengers on a moving street car heard an entertainment broadcast by the Detroit News station.

Modart Corset Co. at Saginaw has installed radio for entertainment of employees during rest hour.

Practically all of Detroit's high schools will have radio courses this fall.

WCX, Detroit reached Saranac Lake, N. Y., with music to cheer victims of tuberculosis in camp there.

Marquette reports that installation of radio on lake boats has proved useful and entertaining.

NEBRASKA

Omaha is testing the use of radio on its police automobiles.

The Omaha World Herald broadcasts programs by arrangement with the Omaha Grain Exchange station.

The Omaha Bee broadcasts programs through the Omaha Grain Exchange station WAAW.

OHIO

Fred King, aviator, flying from Chicago to Cleveland, heard an orchestra concert from KYW, Chicago, while he was speeding along 2,500 feet in the air.

John H. Chase, head of the playground association, says Youngstown's 1,000 radio fans should federate for mutual benefit and assurance that addresses and concerts which they wish to hear will be broadcast. Mr. Chase was disappointed at failure to broadcast a speech by Secretary Herbert Hoover, delivered in Youngstown.

NEW YORK

John H. Morecroft, associate professor of Electrical Engineering at Columbia University predicts 5,000,000 receiving sets will be in operation in the United States within five years.

Dr. R. B. Henline, ship's surgeon on the SS "America" was puzzled by the symptoms of a patient when the vessel was 500 miles out at sea. He communicated by radio with a New York specialist and the patient was restored to health.

The station atop the Walker Lispenard building in New York City is said to be the highest. Towers 100 feet tall support aerials above the roof of the 24-story structure.

NEW JERSEY

Mrs. Avery Lord Elizabeth, reports that she picked up Chicago with a crystal set. Experts say it could only be done with the aid of freak currents.

Radio Aids Davenport

Radio, to catch criminals, is a new law enforcing weapon put into the hands of the Davenport police department today by Dr. B. J. Palmer, who has donated to the city the use of his powerful wireless station at any time the police may call for this help.

An automobile is stolen.

The thief speeds toward Des Moines.

The theft is reported to the police.

The police call the P. S. C. radio station.

Broadcast, to 20,000 stations within a radius of 300 miles of Davenport, goes the notice of the theft, the make, model, description and license number of the stolen machine. Farmers who receive weather and crop reports by radio daily, get the description of the missing car and are put on the lookout for it. Police in the towns around are notified by the amateur wireless operators and inside of a few minutes a network of invisible wireless waves is tanglefoot for the feet of the thief.

This broadcasting of crime notices will be used for all classes of misdeeds in which the police believe the criminal may have left for other cities. No matter what business it is transacting, the Palmer School of Chiropractic radio will stop and broadcast the crime warning whenever the Davenport police chief calls for this service. The chief believes it will be a big help and Dr. Palmer is enthusiastic over its possibilities.—Davenport (Ia.) Democrat and Leader.

The American Art Mache' Company, Chicago, some time ago developed a process of die-casting wood fiber into any desired form. Their earlier products included a wide range of wood castings to replace hand-carved wood, as for instance in interior trim for fine homes for statuary, etc.

But their discovery that "Maderaware" had remarkable acoustic properties for horns for radio has led them to abandon practically every other line of manufacture and to concentrate their large producing facilities upon the manufacture of radio horns.

The Radio Corporation of America has issued a new publication "Radio Enters The Home," which comprises descriptive matter on the highest quality radio apparatus available for public use.

Ammeters and Voltmeter

A direct current ammeter connected in circuit with the filament of a tube will show whether or not the filament is receiving the proper circuit for best operation, and whether the current is steady or variable. A variable current means poor contact or that the "A" battery needs charging. For a single tube, an instrument of 1.5 or 2 amperes capacity is sufficient for most of the tubes commonly used. For one or more stages of amplification, an ammeter should be connected in each filament circuit separately.

Some sets are operated satisfactorily using a voltmetre across the filaments of all tubes and adjusting according to voltage.

Both the ammeter and the voltmeter will show loose connections and will provide a visible means of adjusting so that "previous settings" which have proved satisfactory may be duplicated immediately. A direct current voltmeter of a range 0-8 or 0-10 volts should be used to test the "A" battery to ascertain if it is properly charged.

It is always essential to good operation to have plenty of "B" battery voltage. These batteries do not deliver much current and are made up of a number of small cells connected together and sealed up in wax. The voltage of a "B" unit is about 22 volts, so that a voltmeter of 25 volts range would apply for each unit. Since the number of "B" battery units may be varied, a voltmeter for each unit is more satisfactory. In case of trouble, each unit should be tested separately to find out if the voltage is low.

Without instruments, in case of trouble excessive current may be applied to the filament, lessening the life of the tube.

The ammeters and voltmeters manufactured by the Westinghouse Company are similar to the large instruments used by that company at its radio broadcasting stations. Both types of instruments are made with a variety of scale ranges and in several styles, some in portable cases and others for mounting permanently on panels. Type BX ammeter and PX-2 voltmeter are favored by most radio enthusiasts due to their greater accuracy.

Send $1.00 to Radio Age, 64 Randolph street, Chicago, and receive this middle-west radio periodical for six months. Regular subscription price is $2.50 a year. Thus you will be getting two months free.

"I have used Combat batteries in my work and at school for the past 10 years and consider them the highest type of battery constructed. I am now using the Combat Radio in my Radio work"—says Frank D. Pearne, noted Radio authority and teacher.

A Battery Built For Radio Only

CHic c c c a Go—messages like that are the great bane of Radio. They are caused by voltage variation—and the Combat "A" uniform voltage Radio battery corrects voltage variation. The extra-heavy, hand-pasted plates in the Combat Radio deliver a discharge that is slow and uniform, thereby eliminating distorted messages. Made exclusively for Radio work—if you own a vacuum tube set you need it. The Combat Radio is built into a handsome acid-proof steel case which houses the one-piece hard rubber jar. Special composition between protects against breakage or leakage. Patent vent plug allows escape of gases but no acids. Well in jar insures against spilling while filling or charging.

Patented non-corroding terminals keep your connections clean at all times—no short circuiting. Fully guaranteed for 18 months by the manufacturers who enjoy reputation of 14 years' high-grade battery making.

SPECIAL OFFER: 5,000 will be sold direct to users at factory prices in order to introduce. This is an opportunity to save money on the best Radio battery ever produced. Some Combats have given as high as 8 years' continuous service. Great length of life more than makes up for any difference in price. Take advantage of this offer NOW. Act Quick to Buy at These Prices.

Full capacity 6 v., 60 amp.....$15.25
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Send only $1.00 as good faith and we will ship C.O.D. subject to examination.

Territory still open for live dealers.

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There are thousands of subscriptions for Radio publications taken every day.

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"The Magazine of the Hour," is placing representatives in every community throughout the country. Why not turn your spare hours into dollars. Experience is not necessary. We show you how. Clip this ad and mail it today.

RADIO AGE
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Featured in the Radio Shops

Experts of the Future

It is predicted by the large manufacturers that the radio business during the coming season will far exceed that which we have just gone through. They tell us that over $100,000,000 worth of apparatus and outfits will be sold.

And will all this radio equipment install and take care of itself? How many busy men are there who want a receiving set in their homes but do not have the time to install it and maintain it? How many are there who are not sufficiently acquainted with the art to be able to do the work efficiently by themselves?

This creates a demand for a new type of man—the Radio Service Man, the Radio Expert—who is thoroughly acquainted with all the finer points of radio practice. The successful Radio salesman will be the one who understands the subject from A to Z. The manufacturers will need radio-trained men to install newly purchased equipment in the customers' homes. They will also need similar men for "trouble shooting," for the radio public will soon demand service in much the same way that the automobile owners or the telephone subscribers demand that their equipment be maintained in proper operating condition.

It is with these important facts in mind that A. G. Mohaupt, who is at the head of the American Electrical Association at Chicago, has prepared a specialized home study course on the Practice and Theory of Modern Radio. The lessons are for the practical man, full of practical operating information. They are written in clear, concise form, in simple every-day language, so that they can be grasped by anyone who is capable of reading the English language. They cover every important point that the man must know who wishes to construct, install, repair, operate, maintain and sell Radio equipment.

One of the interesting exhibits at the Leiter Building show in Chicago was that of the Jewell Electrical Instrument Co., 1640 Walnut street, Chicago. The Jewell company displayed a complete diagram of a continuous wave set with the various instruments in place in the diagram.

Big Research Studio

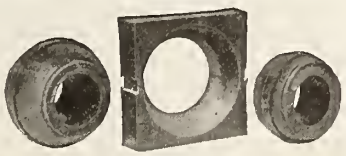
The Ra-Di-Co Organization, Inc. has established a new studio with over 3,600 square feet of space devoted to demonstration and experimental research work at 1215 Leland Avenue, Chicago. Every evening in this auditorium as many as 300 people can congregate and be entertained free of charge with the best of concerts, operas, bedtime stories, etc., from the local broadcasting station. In connection with this demonstration room is a special studio, size 15 x 16 ft. with special soundproof walls. This studio is equipped with a pick-up microphone. A particular feature in the Ra-Di-Co demonstration rooms are the special booths built around the room where radio apparatus can be tested out before being purchased by a radio enthusiast.

The directors are: Ralph S. Drummond, member of American Institute of Electrical Engineers, Royal A. Stemm, Phillip Henderson and C. W. Hawthorne.

One of the centers of attraction at the show which just closed in Chicago, was a Knock-Down Set exhibited by the NASH-ODELL Co. of 172 N. Franklin St., Chicago, Ill., who are thereby supplying the demand created by the man who desires to assemble his own equipment without the need of shopping around for parts and experiencing the grief of panel drilling, etc.

This apparatus includes standard tested parts, a ¾" solid hand finished cabinet, a panel 12" x 21", shielded, drilled and engraved, wire, spaghetti, solder, screws, nuts, etc., making an equipment at a price less than one-half of usual figures.

Artistic Variometer Parts



Variocouplers,
Rotors, Winding Forms, Stators,
in Genuine Mahogany.
Quick Deliveries. Write for prices.
Artistic Wood Turning Works
517 No. Halsted Street, Chicago, Illinois

The Rheostat's Big Job

The necessity for a rheostat that would give finer adjustment than any on the market was soon realized after radio got well under way. The advent of Radio Frequency emphasized this still further.

J. E. Jenkins, of Chicago, an inventor and radio engineer, worked out the first Vernier rheostat and the immediate improvement that this invention gave to the selectivity of receiving sets, set up such a demand for this rheostat that Mr. Jenkins placed orders for large quantities and is now selling them under their firm name, J. E. Jenkins (Not Inc.). The principle of the rheostat is a wire wound around a solid horn fibre drum in which a screw thread has been cut. The wire lies in the bottom of the cut. Contact is made by a pointer attached to the shaft of the rheostat; and, by turning to right or left, the resistance can be lessened or increased as desired, with infinitely small resistance variations.

One of the most attractive features of the rheostat is the fact that instant contact can be made by means of a switch connection which is part of the rheostat. By simply pushing the knob the circuit can be broken, and when the filament current is again required, a pull on the knob connects the circuit and the filament is heated at the same resistance as when the circuit was disconnected. This is a big advantage and saves considerable trouble by not having to continually readjust the rheostat every time you get ready to use the set.

Organize for Protection

The National Co-Operative Radio Society, with headquarters at 214 Saratoga street, New Orleans, calls on all owners or prospective owners of radio receiving sets to join that society for the purpose of preventing the larger interests from monopolizing the allotments of wave lengths and periods of sending. The society proposes to collect yearly dues of $12, one of the results promised being the establishment of a nation-wide chain of broadcasting stations which shall send out what the radio fans want rather than what they are forced to take.

National Radio Club

Pittsburgh, Pa., is the scene of the organization of a club that seems destined to play a big part in the future of radio. The work of enrolling members is already well under way and articles of incorporation have been filed along with application for a charter.

While one of this club's fundamental purpose is to promote and finance the installation of radio equipment in hospitals, it will also use its influence to keep the broadcasting art on its present high plane; enlarge musical and educational radio programs; keep all members informed regarding developments, improvements and news of interest regarding radio; answer, without charge, all technical questions asked by members; receive and file articles written by members for reference, lend the moral support and influence of the club to those agencies endeavoring to eliminate the contusion of signals; promote fraternity and good fellowship among members with the aid of a distinctive official button and card of membership.

The organization committee includes Harold B. Coe of New York City, Charles W. Payne of Philadelphia, F. R. McCray of Los Angeles, Otto J. Palm of Cincinnati, R. Gordon Craig, Ray Mansman, and Francis G. Albertson of Pittsburgh, all radio enthusiasts who are sparing no effort ,to promote the interest of radio transmission.

A nominal membership fee of two dollars will be paid by applicants who will have issued to them a membership card and club button. Among the possibilities envisioned for the future by the club directors are courses of instruction designed to enable members to pass examinations for operators' license.

Interested persons can get in touch with the club by writing to Francis G. Albertson, Secretary, 419 Fulton Bldg., Pittsburgh, Pa.

TRESCO

Sectional UNIVERSAL Radio Outfits

Licensed under Armstrong U. S. Patent No. 1,113,149

The Set Consists of Three Units:

Tuner and Detector Unit....	$ 50.00
Two-Step Amplifier Unit....	35.00
Unit for holding "A" Battery Top and Bottom, which when added to the three other units, make a complete section all in one. Each, $5; both	9.50
	10.00
Complete Set, Total.....	$104.50

Ask your dealer; if he cannot supply you, write us, Dept. 803.

TRESCO RADIO

Davenport, Iowa, U.S.A.

Patent Rights

The Editor of Radio Age is in receipt of the following letter from Independent Radio Manufacturers, Inc., 165 Broadway, N. Y., of date June 30, 1922. As the warnings of patent infringements have attracted some attention we publish the communication as a matter of legitimate discussion of interest to the radio trade generally.

A number of our members have called to the attention of our Board of Directors that certain warning advertisements have been appearing in recent trade publications at the instance of the Wireless Specialty Apparatus Company of Boston and New York.

We commend to your attention the following facts:

1—That the validity and scope of the patents listed in the warning advertisements, some twenty-one in number have not been determined by adjudication in the courts and are, therefore, open to question and, matters of defense, together with the question of infringement in each particular case.

2—That because of this fact, it is improper to create a false impression in the trade to the detriment of crystal manufacturers by representing to the jobbers and dealers, as is done in this form of advertising, that the common type of crystal, crystal detector and crystal radiophone receiving sets are infringements upon incontestable rights of the advertiser founded upon one or more of twenty-one patents listed, whereas in addition to the fact that not one of these patents has been before the courts for adjudication, the majority of the listed patents, if conceded to be valid are not infringed.

3—That in justice to your advertisers of crystal sets, who question the validity of these patents and deny infringement upon the advice of their counsel and therefore do not recognize the validity of the claims made by the Wireless Specialty Apparatus Company, such advertising should not be accepted by you.

4—That certain magazines have already seen fit to refuse this advertising.

5—That it is our duty to our constituency to notify the manufacturers of crystals, detectors and crystal sets that their advertising is of questionable value in those publications which carry the aforementioned warning.

Distribution of foreign trade news and dispatches by radio as a means of informing American business men of developments in the fields of industry and commerce abroad is being given a trial by the commerce department at Washington. On July 11 and 12 the latest cabled news of foreign markets and trade opportunities received from abroad was sent by radiophone to the meetings of the New England shoe and leather association.

Send $1.00 to Radio Age, 64 Randolph street, Chicago, and receive this middle-west radio periodical for six months. Regular subscription price is $2.50 a year. Thus you will be getting two months free.

Dr. Jewett's Own Story

HORATIO ALGER and some of the other better known boys' authors have the satisfaction of knowing that they started at least one well known executive along the road to fame. Among a series of human interest stories appearing in the Western Electric News, the employees' magazine of the Western Electric Company, is an amusing anecdote by Dr. F. B. Jewett, vice president of the company and president-elect of the American Institute of Electrical Engineers, entitled "How I Earned My First Dollar."

Dr. Jewett who is recognized internationally as one of the world's best informed communication engineers particularly as a result of his developments in the fields of radio and long distance telephony, attributes his first research work to a desire to be freed from anything that might distract from the usual boyish literary desires. In describing the capture of his initial greenback he says, "My first pay envelope as a boy—was for running an engine and boiler for a fertilizer works. Quite far removed from telephone engineering, was it not? In addition to earning me my first money I think that the job gave me the opportunity of doing my first real research work. We had one of the first oil burners developed for using California crude oil, and I exercised my ingenuity in endeavoring to adjust the burner, the water pump and the engine so that I would have a minimum of interruptions in my reading exciting boys' books, where my real interest lay at the time."

Just how much that first research effort contributed to the awakening of Dr. Jewett's inventive genius is unknown. Suffice to say that it was the first step in a career that among other things found the Bell System executive one of Uncle Sam's most important lieutenants during the war. Dr. Jewett served as a colonel in the Signal Corps and was also an advisory member of the Special Submarine Board of the Navy where he participated in the perfection of super-sensitive devices for detecting hostile submarines.

3000 OHM SETS, $4.50

2000 OHM SETS, $4.00 1000 OHM SETS, $3.50

Plus 20c for Postage and Insurance.

Satisfaction Guaranteed or Money Back

We mail phones the day your order arrives. Every pair tested, matched, and guaranteed as sensitive as $8 to $10 phones. We have no agents or dealers. By ordering direct you save dealer's profits—circular free.

TOWER MFG. CO., Brookline, Mass.
22 Station St.

The "Oxaphone"

An Inquiry by Geo. E. Carlson, Commissioner of Gas and Electricity, City of Chicago.

Editorial Note—The Editor does not vouch for the authenticity of this article, but it is published on the assumption that "A little humor now and then is relished by the best of men."

MR. GEO. E. CARLSON, Commissioner of Gas and Electricity of the City of Chicago, has many strenuous duties in his capacity as head of the Department of Gas and Electricity of the City of Chicago. But when time will permit a moment's diversion from the task of running the street lights, electrical inspection, fire alarm and police telegraph systems, and other activities, Mr. Carlson will be found investigating some new "stunt" in the radio field. A device known as the "Oxaphone" was recently called to his attention by some of his friends. Inquiry was immediately made by Mr. Carlson, who assigned the investigation to J. C. Hail, Electrical Engineer in Charge in the department, who among his other duties is in charge of the City Hall Radio Station WBU. The following is the memoranda of orders and reports pertaining to this new device:

May 26, 1922.

Hail:—

A device known as the "Oxaphone" has been called to my attention. What is it?

Carlson
Commissioner.
May 26, 1922.

Mr. Carlson:—

The "Oxaphone" is a device for "cutting out the bull" from telephone conversations. It can be attached to any radio microphone or ordinary telephone.

Hail
May 27, 1922.

Hail:—

We have great need for the "Oxaphone." Please make complete report.

Carlson
Commissioner.
May 31, 1922.

Mr. Carlson:—

With further reference to the "Oxaphone," and the manner in which the device is able to eliminate the "bull" from radio telephone or ordinary telephone conversations, a further examination was made in accordance with your instructions.

The word "bull" is a slang expression to indicate a particular quality now prevalent in most radiophone broadcasting addresses and ordinary telephone conversations. This quality consists of a certain variance from the truth and other slang words to express the same thing are "bunk," "salve," "jolly" and the like.

The mechanical construction of the "Oxaphone" is very well adapted for the purpose intended. The device consists of two parallel plates in which the "bull" is held. The plates further act as barriers over which the "bull" cannot pass. Fastened to the end of each plate is a spiral spring which is so constructed that it will prevent the formation of a lasso with which to "throw the bull." The handle and attachments are so designed that they cannot be gripped by a "cow-puncher" who might "throw the bull."

Time has not permitted any tests to be made to determine the efficiency of the device. Further it was considered inadvisable to attach the device to any of the departmental telephones, because of a possible decrease in the satisfactory operation of the telephone under test from a business standpoint. If you desire tests made, shall we attach the device to the telephone on your desk?

Hail
June 1, 1922.

Hail:—

Not to my telephone. Attach to your telephone, which is more suitable for the purpose.

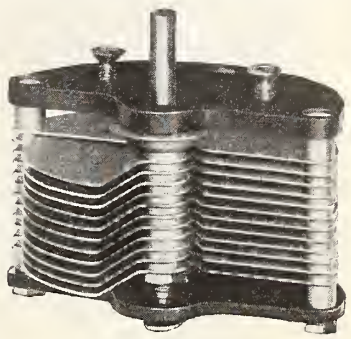
Carlson,
Commissioner.

Birmingham's WSY

"W S Y" operated by the Alabama Power Co., is of 200 watts capacity, and consists of a 2-foot diameter cage type aerial, mounted on 60-foot towers, with counterpoise; a tuning helix; two 50-watt vacuum tubes acting as oscillators and two as modulators for producing the so-called carrier wave; and other tubes and auxiliary apparatus for varying the amplitude of the carrier wave in accordance with the vibrations produced with music, voice or whatever is broadcast.

This equipment is mounted on a panel board, together with the necessary electrical measuring instruments for observing the operation of the set. The motor generator set is required to produce a high direct voltage in connection with the operation of the tubes, and the storage battery is used to light the filament of the tubes.

Variable Condensers



Variable condensers to be efficient must be well made. Loose joints or faulty construction soon allow the plates to get out of alignment and decrease their efficiency.

A seasoned organization backed by a half million dollar equipment has placed the United Condensers in the front rank with radio engineers, the country over.

PRICES

43 plate.....$4.50
23 plate..... 4.30
11 plate..... 4.00

without dial or knob.

Liberal discounts to jobbers and dealers.

We invite correspondence with Radio Manufacturers who are interested in using our facilities and services for manufacturing Radio Equipment.

United Mfg. and Distributing Co.

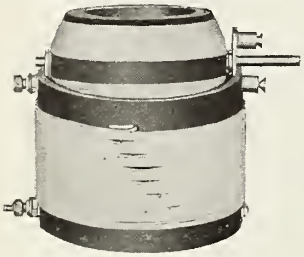
536 Lake Shore Drive
CHICAGO, ILL.

VARIOMETER

$5.00

Rotor and stator in moulded hard rubber, highly finished, best insulation known. Beautiful design binding posts, eliminating any necessity of soldering. Finished product. Wound with green covered wire; nickel plated hardware. Put up in attractive boxes.

COUPLER



$4.50

Tube of hard fibre, rotor in moulded hard rubber. Wound with green covered wire. Nickel plated hardware. Special binding posts. No soldering of connections.

The set herewith illustrated is a four tube Radio-frequency set built into a lightweight, portable case with nickel-plated hardware, making a handsome, simple and salable set. Prices on sets range from **$65.00 to $190.00**, including tubes, B Batteries and head phone. These sets can be taken wherever you go, being light and convenient to carry.

VARIABLE CONDENSERS

Aluminum plates, fibre and brass end pieces. Sturdily and well constructed.

11 plates.....$3.00
23 plates..... 3.50
43 plates..... 4.50

3" Dials and composition sockets of attractive design at 75c each. Rheostats with pointer, $1.10; with dial.....$1.50

POSITIVE IMMEDIATE DELIVERY FROM STOCK

We have an interesting proposition for dealers and jobbers

The Reliance Rubber Co.

Dept. D **1806 S. Michigan Ave.**

PHONE CALUMET 0947

CHICAGO

(Continued from page 22)

tee meeting referred to in the opening of this article.

Future Uses

No prediction as to the future uses and applications of broadcasting can be too broad. There will be no greater unifying factor in our national life. The immense advantage of a universal national language such as we have is not fully appreciated in this country because it has never occurred to us that any nation would use more than one language in its intercourse. Those of us who have a clear conception of the national conditions in some of the European countries where several languages are spoken realize what a common language means to the nation.

Now that in broadcasting we have a means of transmitting this common language to practically all the nation at one time, the effect in knitting us together as a nation cannot be overestimated. It may play a great part in our national legislative activity and the day may come when the speeches of senators and congressmen may be sent out from a broadcasting station covering the entire nation. The President may issue his national proclamations by radio telephone. National political campaigns will no doubt be waged by means of speeches broadcasted by the candidates. Selective system of broadcasting may develop by which subscribers can obtain the particular character of information or amusement they desire without the possibility of being interfered with by other stations.

Broadcasting has already supplemented the newspapers to a wonderful extent and may greatly increase their activities. Its value to farmers or others living at remote points where newspaper information is not easily accessible is beyond calculation. Already the live stock and grain reports information sent out by the Department of Agriculture regarding farm projects and business has met a response indicating that this is one of the most important fields of service in radio broadcasting. Here is the means that brings the information to the radio listener even quicker than it would an auditor in audiences of ordinary size. In many parts of the middle west the farmer is guided almost entirely by the information he obtains from the Westinghouse station at Chicago, which broadcasts quotations every half hour of the Board of Trade operations. Local brokers handle the farmer's orders which his country line telephone enables him to place upon the receipt of the guiding radio information.

President Roosevelt during his administration appointed a commission to endeavor to devise means to keep the farmer, in the words of the old song, "down on the farm." Broadcasting will accomplish more in this direction than any means yet devised. Moving pictures and the broadcasting brings cosmopolitan life into the most remote farming regions. Public health instruction is sent out from one government station and the function will no doubt be greatly increased.

Selectivity in Broadcasting

However, in closing this article, the most important impression that we desire to leave is that unlimited broadcasting activities, instead of attaining all the objects outlined heretofore, will, rather, prevent successful attainment. Free speech does not mean that we can all talk at once, and only those with a real message can get attention. Many of us labor under the delusion that we are called and have such a message, but if we speak only in behalf of ourselves or repeat platitudes we add to the din but not to progress.

Unfortunately, the elements controlling radio limit the number of stations that can operate successfully within limited wave bands or geographical areas. The public must decide whether it shall endeavor to pick out the worthwhile message in a bedlam of broadcasting that may come with the establishment of a large number of stations or whether they prefer to limit and classify the broadcasting stations, granting them a license which will carry some of the exclusive features and advantages of a franchise and with its continuity dependent upon the maintenance of a certain standard of excellence and revocable when it is evident that the station no longer fulfills the public demands.

Radio broadcasting stations are now fulfilling a public service without any direct recompense and it is an old adage that things obtained gratis are not always appreciated. It behooves the radio public to consider carefully the effect of unlimited broadcasting and to take an active interest in the radio laws and regulations which may be formulated to control it.

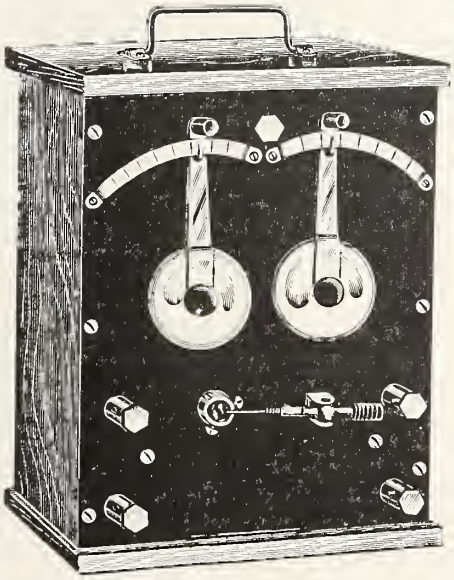
RADIO MANUAL, everything the beginner should know. How to build and operate an inexpensive receiving set. Sixty-four pages, thirty illustrations. Twenty cents. Postpaid. RAYDIO PUBLISHING COMPANY, CAXTON BUILDING, CLEVELAND, OHIO.

FREE—With Head Phones
Compact, High-Class Receiving Set

Looks Well and Performs Well

THIS instrument is assembled in a walnut cabinet with a highly polished Bakelite front, all metal parts highly nickeled.

The Crystal Detector is of the very latest pattern, with ball and socket arrangement, so same can be moved up and down, sidewise and forward and back so that the most sensitive point on the Galena can be located.



The Galena retainer is of standard size so that all mounted Galenas will fit it.

The size of the set is as follows: Height, 10 inches; width, 8 inches; depth, 6½ inches.

There are two tuning levers on the front. After locating the most sensitive point of the Galena the two levers are moved back and forth until the best result is obtained.

This receiving set WILL NOT receive messages from great distances but it works perfectly under favorable conditions from 15 to 25 miles away from the broadcasting station.

Each receiving set is guaranteed to be in perfect condition, being thoroughly tested before accepted from the factory.

You Can Get This Wonderful Radio Receiving Set

FREE

if you are willing to devote a little effort in telling your friends about RADIO AGE. It's as simple as A. B. C. Just write your name and address on the coupon below and we'll send you full particulars by first mail out.

RADIO AGE, Circulation Department
64 West Randolph Street, Chicago

Date.....

I am interested in securing one of your Radio receiving sets which you offer FREE. Please send me full particulars by return mail.

Name .....

Street .....

City..... State.....

RADIO AGE INSTITUTE

To insure 100% value to readers of advertisements, as well as 100% value to the advertisers themselves, radio equipment is now being tested and indorsed by the

RADIO AGE INSTITUTE

64 WEST RANDOLPH STREET
CHICAGO, ILLINOIS

No charge is made for testing and approval, and all merchandise will be returned as soon as possible, transportation expenses to be paid by the manufacturer. Lists of makers of approved radio goods will be published from time to time.

SERVICE DEPARTMENT FOR READERS

Please remember that Radio Age has one of the best radio instructors in the United States, who is ready to answer any technical question. This costs you nothing.

RADIO AGE

The Magazine of the Hour

September, 1922 Price 25 cents

PAINTED BY JAMES HART, AFTER KEYSTONE PHOTO

How To Make a Cheap Reinartz Set—In This Number

RADIO AGE INSTITUTE

To insure 100% value to readers of advertisements, as well as 100% value to the advertisers themselves, radio equipment is now being tested and indorsed by the

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RADIO AGE

The Magazine of the Hour

Volume 1 *Number 4*

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Do It Better!

Any radio magazine that keeps pace with radio must be a magazine that improves materially with each issue. Radio is going forward by leaps and the boy who is operating a small receiving set today is the broadcaster of tomorrow.

With pleasure, therefore, we offer our readers this month a magazine in a brand new dress, for appearance sake, and contents that cannot fail to grip the interest of fans everywhere.

Everybody is talking about the Reinartz tuner. Professor Pearne in this issue tells how to make a Reinartz outfit at small expense, which will enable the maker to hear stations up to 1,500 miles distant.

Also everybody is talking about the Armstrong Regenerative Circuit. Mr. Pearne tells how a novice built one for his car that worked perfectly. Diagram accompanies article.

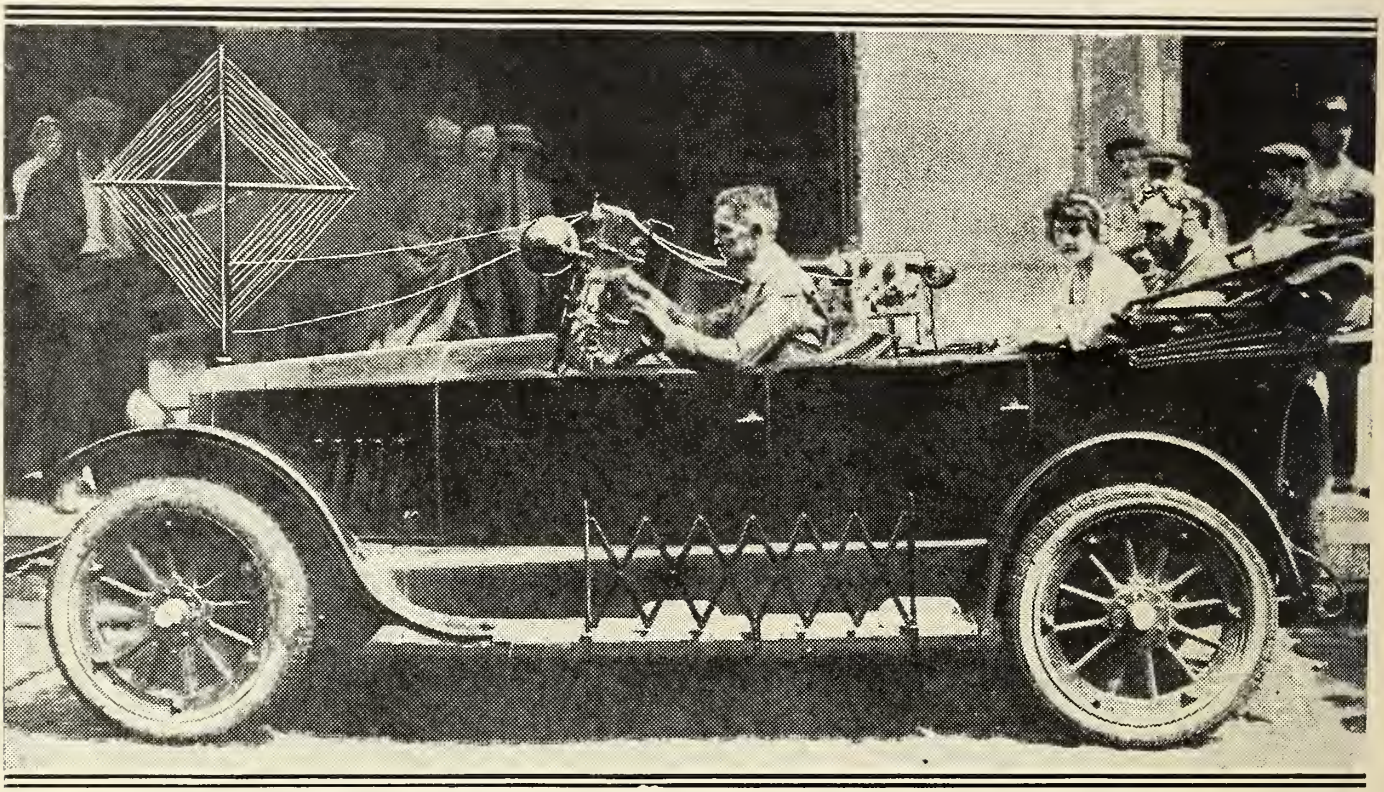
Everybody wants to know where and what the new broadcasting stations are. A list is published in this number.

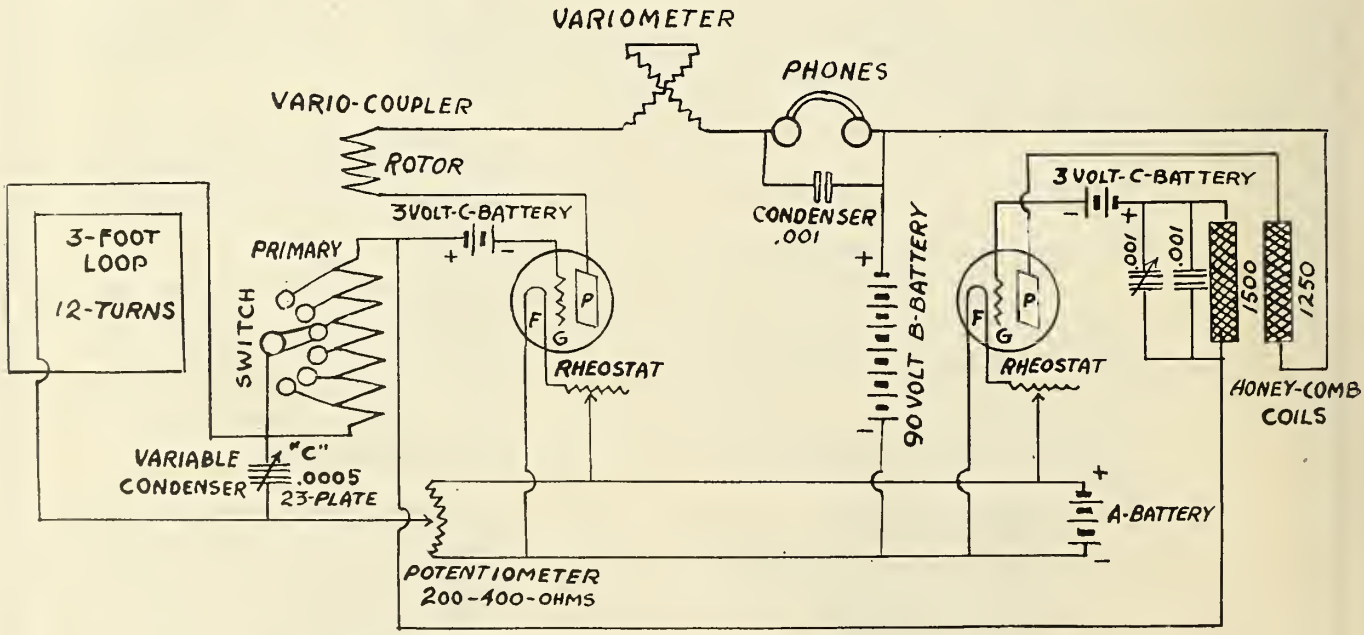
Everybody wants to know which stations send out market, crop, weather, and other useful news reports. The list of hundreds of stations in this number covers the entire United States.

Next month we will publish the Bureau of Standards illustrated article for amateurs on how to make a tube detector set at small cost to replace the crystal set which has been outgrown. This is an official government article. Don't miss it.

Read RADIO AGE for information carried in no other daily, weekly, or monthly radio publications.

This Auto-Man Solved the Circuit





ARMSTRONG SUPER-REGENERATIVE CIRCUIT.

Above is a photograph of Paul B. Coats, in his car, in which he has installed his own Armstrong super-regenerative set, with loop aerial set into the radiator cap. Mr. Coats is sitting at the wheel. Below is a diagram of the circuit which Mr. Coats used in this remarkable outfit, and with which he has received messages from stations as far away as Newark. See descriptive story of Mr. Coats' set on opposite page.

RADIO AGE
"The Magazine of the Hour"
M. B. SMITH PUBLISHER
PUBLISHED MONTHLY GARRICK BLD'G CHGO.
FREDERICK SMITH EDITOR

Novice Gets Good Results With Armstrong Super-Regenerative Circuit

By F. D. PEARNE

WHILE many radio experts are wrestling with the new Armstrong super-regenerative circuits, trying to find the best one and to solve the problem of getting them to work, along comes Paul B. Coats, an amateur of about sixty days' experience in radio work, with a real Armstrong circuit set up and working splendidly in his automobile. Mr. Coats is Vice President of the Milburn Puncture Proof Tube Co., located at 336 W. 47th Street, Chicago, Ill., and became inoculated with the radio bug just two months ago.

Unlike most beginners, who are satisfied to start out with the crystal detector and tuning coil, he aimed higher and, after building three circuits of the Armstrong super-regenerative type, was rewarded with the successful outfit which he is now using. The circuit uses only two tubes (both amplifiers) and is conspicuous in the absence of any complicated apparatus. With a three-foot loop of twelve turns mounted on the radiator of his car he can listen in and get Kansas City, Denver, Detroit, Indianapolis, Pittsburgh and Newark.

Now, I know what you are going to think: "Another newspaper story," and this is the reason that I am giving Mr. Coat's address, so that the skeptical readers may get in touch with him and receive first-hand information. The most interesting feature of this outfit is the fact that location does not seem to affect it. For example, with the car parked at the waters' edge in Milwaukee, Wis., KDKA at Pittsburgh was picked up, and upon moving the car to the top of one of Milwaukee's famous hills, no difference in the reception could be noticed. Another noticeable feature is the lack of interference from local disturbances. Mr. Coats very generously offered to draw up his circuit for the benefit of those who are interested in these different Armstrong circuits. The diagram is a reproduction of this circuit.

PAUL G. WOOD, Hilliard, O., who is a radio camper.

The loop consists of twelve turns of wire on a frame three feet square. A variable condenser "C" of .0005 M. F. (23 plate) is connected across the terminals of the loop. The vario-coupler used is of the ordinary type, but I would suggest the use of one in which the roter could be continuously revolved, for the reason that no connections will have to be changed in testing, as this allows reversing the direction of the winding by simply turning the dial 180 degrees.

The variometer should also be arranged so that the roter can turn all the way around. This is not necessary, however, but it makes it unnecessary to reverse the connections, if when testing it is found that connections should be reversed. The phones are shunted by a .001 condenser (a 43-plate variable will do). Two honey-comb coils of 1,500 and 1,250 value respectively are placed in inductive relation as shown. These should be placed on the regular mounting so that the distance between them may be varied for adjustment. Two condensers, one a fixed condenser of .001 M. F. and one a variable of .001 M. F., are placed in parallel across the terminals of the 1,500 honey-comb-coil.

A "C" battery of three volts is connected in each of the grid circuits as shown. These can be two small dry cells, such as are used in flashlight work. The negative side should be connected to the grid. The "B", or plate battery, is ninety volts. The lower end of the loop connects to the arm of a potentiometer, which is connected across the "A" battery. A switch should be connected in the "A" battery circuit, so that the current can be cut off from the potentiometer when not in use, to prevent waste of current. This potentiometer can have any resistance from 200 to 400 ohms. It will be noticed that the upper terminal of the loop connects, not only to the condenser, but also to the end of the primary winding of the coupler, and to the switch lever. The tubes are both amplifying tubes.

Bank Uses Radio to Serve Public

Timely Service of Cleveland's Largest Bank Fills a Real Need in 500-Mile Radius

THE Union Trust Company of Cleveland announces, through Mr. A. H. Scoville, Vice President in charge of the Bond Department, the installation of a radio broadcasting station, in operation August 15.

The new station will be a 500-watt outfit of the very latest design which, under favorable conditions, has an effective radius of 500 miles.

From 9:00 until 9:45 and from 10:00 to 10:45 in the morning, and from 2:00 to 2:45 and from 3:00 until 3:45 in the afternoon the new Union Trust Radio Broadcasting Station will send out full and authoritative information on the major movements in the stock and bond market, together with latest prices on farm and dairy products. Intervals between quotations will be filled with the important financial news accumulating over the private wires of the Union Trust Company.

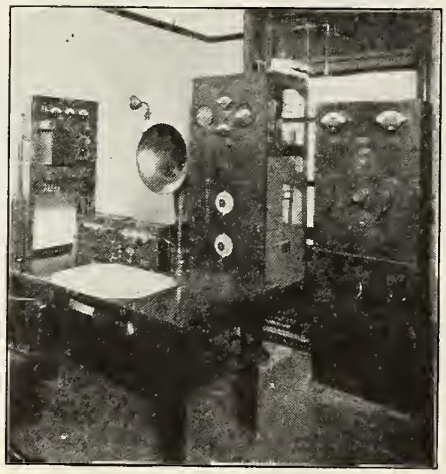
The new station will bring not only to the city dweller who owns a receiving set, but to the farmer as well, up-to-the-minute information on the major movements of the financial world, together with the vital news of all the markets. It will enable the farmer, who does not himself own a receiving outfit, to call up his local bank, who will have a receiving set, and obtain the very latest quotations on his farm and dairy products, insuring proper buying and selling upon the farmer's part. It will enable the city dweller, within a radius of 500 miles from Cleveland, to obtain the very latest news from the financial world.

In effect, the Union Trust radio broadcasting station will supply practically the entire Fourth Federal Reserve District with an up-to-the-minute four-times-a-day newspaper of the events of importance in the commercial and financial world.

Once a week, in the evening, from 7:00 to 8:00, the very best entertainment program available in Cleveland will be broadcasted.

This timely innovation by the Union Trust Company again marks Cleveland as the leading financial center of the Middle West, for the new station will render a financial service literally broadcast over a radius of hundreds of miles and will give the banker in the smaller towns, his customers and all others using radio receiving sets, the very concrete advantages incident to the private wires and other unusual machinery peculiar to a large bank like the Union Trust.

Lobby and window bulletins will be supplied banks with receiving sets throughout the Fourth Federal



Radio Room in Cleveland Bank.

Reserve. These bulletins will be changed twice daily and will contain quotations on the more active stocks and bonds, with the latest movements in the money market, in addition to such financial and commercial news as may be of interest to the general public.

It will enable the bank customer in the hundreds of cities surrounding Cleveland to be in four-times-a-day contact with the elaborate wire and information service at the command of The Union Trust Company and it will make Cleveland the pivot for the latest thing in banking service.

No effort is being spared by The Union Trust Company to make their sending station one of the most complete in the country. It is the equal of any commercial sending station at the present time and Mr. Scoville promises that every endeavor will be made to keep it up to date in the minutest particular, for, as Mr. Scoville well points out, the service which a bank can render its patrons is used comparatively little, but through the radio The Union Trust will render this service to thousands upon thousands of people throughout the entire Fourth Federal Reserve District, thus multiplying the service of The Union Trust Company many hundred times over, while at the same time attracting the ears of the Central West toward Cleveland, and the progressive spirit of service for which Cleveland has always stood.

Wireless Starts Train

In the presence of an assemblage of business leaders of the Pittsburgh district, the International Trade Special, carrying thirty-three cars of equipment for the electrification of the Chilean State Railways, was started recently by wireless from the East Pittsburgh works of the Westinghouse Electric & Manufacturing Company.

This is the first time in history that such a wireless feat has been accomplished and it portends the tremendous possibilities for the use of wireless in railroad work.

The International Trade Special was started on its long journey when E. M. Herr, President of the Westinghouse Company, closed a switch on a pole near the railroad track on which the train was standing. The closing of this switch closed the wireless electrical circuits laid out by radio experts and engineers, and this reacted on the circuits in the locomotive, releasing the controller.

The release of the controller by wireless then started the International Trade Special and marked an event unparalleled in history and in wireless engineering. After the train was put in motion by the wireless arrangement, a locomotive engineer, who was sitting in the cab, in accordance with the requirements of the Interstate Commerce Commission, took charge of the train.

The assembled guests, although expecting to witness an unprecedented event, were amazed by the facility with which the locomotive was started by wireless, and, for a moment, stood silently in wonderment at the feat. Then they started cheering and continued cheering until the long train had left the electric plant.

The shipment, which was the largest single consignment of electrical apparatus for railroad electrification ever made in the world, was the second complete train of railway electrification equipment to be sent to Chile.

How to Construct a Cheap, Efficient, High Grade Regenerative Set

By F. D. PEARNE
Chief Instructor in Electricity at Lane Technical High School

FOR the amateur who wants to build a real receiving set and does not feel that he can afford to spend the money, I submit the following specifications of the Reinartz tuner, which, according to my many correspondents, is giving far greater satisfaction than the well-known vario-coupler and variometer set. This set is claimed by many users, to bring in signals which cannot be heard with the other well-known types, and the small investment required to build it is one of the features which recommend it to the experimenter. All of the inductances are wound upon the same form, which are of the well-known "spider webb" type.

Construction.

The mounting is made by cutting out a disc of fiber one-sixteenth of an inch thick and six and one-half inches in diameter. If fiber cannot be obtained, good heavy cardboard can be used, but it must be very carefully varnished with shellac before the winding is put on. Cut out the disc as described and divide the outside edge into eleven parts. Draw a circle two and one-half inches in diameter upon the disc to locate the bottom of the slots, then at each of the divisions cut a slot one-eighth of an inch wide from the outside edge to the inner circle so marked.

After all the slots have been cut, a coat of shellac varnish, or celluloid cement, is put on and, when dry, the form is ready for winding. It is a good idea to study the circuit as shown in Figure 3 before starting to wind. Note where the taps are taken off, as a great deal depends upon just the right number of turns being used. Leave all taps at least twelve inches long, so that no splicing will have to be done when the inductance is connected to the switches. The best wire to use for the winding is No. 26 cottenamel or silk enamel insulation, although plain cotton insulation will do if the maker is careful in his work. Begin winding at the bottom of any one of the slots, leaving an end at least twelve inches in length for connections. Wind in and out of the slots as shown in Figure 2 until fifteen turns have been put on. In counting

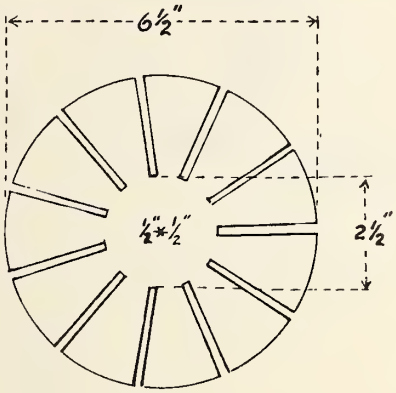


FIGURE 1.

these turns after they have been put on remember that only one-half of the turns will be visible on one side of the disc, so that when seven turns show on one side and eight on the other, it means fifteen complete turns.

When fifteen turns are in place, make a twelve-inch loop, twisting it together, so that this twist will come up tight to the slot, then the tap will not lose its identification among the numerous other taps to come. Continue the winding in this way, taking off a tap at every fifteen turns until sixty turns are in place. At the last turn cut the wire off, leaving the twelve inches for connection. If these instructions have been followed faithfully there will now be three taps and two ends projecting from the disc. It is a good plan to bring out these taps in different slots; that is, the first tap comes out in the next slot to the one in which the coil was started and the next tap in the next slot, etc., as this makes the identification of the wires much easier. This

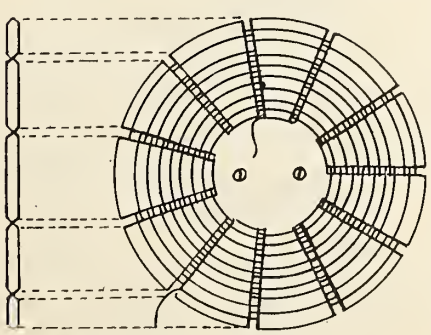


FIGURE 2.

coil is shown at the bottom of the diagram in Figure 3, and is marked "inside coil."

Now start the next coil in the next vacant slot, leaving the customary twelve-inch end; wind one turn only and bring out a loop. Continue in this way, taking a tap off at every turn until you have ten turns. Instead of cutting the wire at the end of the tenth turn, bring out another tap and wind fifteen more turns before you bring out the next tap. After the tap on this fifteenth turn, wind twenty-eight more turns, tapping them at every seventh turn, except the last one which will be a single end, as it is the finish of the winding. Now check up the number of turns with the diagram Figure 3 and see that the correct number of turns have been put on. There should be sixty turns on the inside coil and fifty-three on the outside coil. Now after the winding is completed, paint the coil all over with some insulating varnish, such as shellac or celluloid cement. Both of these windings together will just about fill the form. The best way to mount the coil is to cut off a piece of curtain-pole (wood) about one inch long, place it against the center part of the disc and fasten it to the panel with two brass screws. (Do not use iron screws, as they will tend to dampen the oscillations.)

If the set is to be mounted in a cabinet, it will be better to mount the coil with the piece of curtain-rod on a separate piece of wood, in an upright position, as this will give better access to the wires when it comes time to make the connections. The switches and contact points can be purchased at any radio supply store. Two variable condensers are necessary, one shown at "C" in Figure 3 should have a capacity of .001 M. F. and the one shown at "D" in the same figure should have a capacity of .0005 M. F. The rest of the apparatus required is the same as that used in any other regenerative set, viz.: One grid leak and condenser, one detector tube and socket, one storage "A" battery (6 volts), one plate, or "B" battery (twenty-two two and one-half volts), and one pair

of two or three thousand ohm receivers.

Figure 3 shows how all the connections are to be made, and the builder can mount the outfit as he pleases, either in a box with a panel front, or on a table or base-board. The method of winding the coil is shown at "B" in Figure 2. If this set is carefully constructed, the results obtained will surprise the most skeptical reader and with one step of amplification it will produce results equal to two steps of amplification on the vario-coupler and variometer set. The amplifier, however, should be of a specially designed circuit, which will be explained for those wishing to add it to their sets.

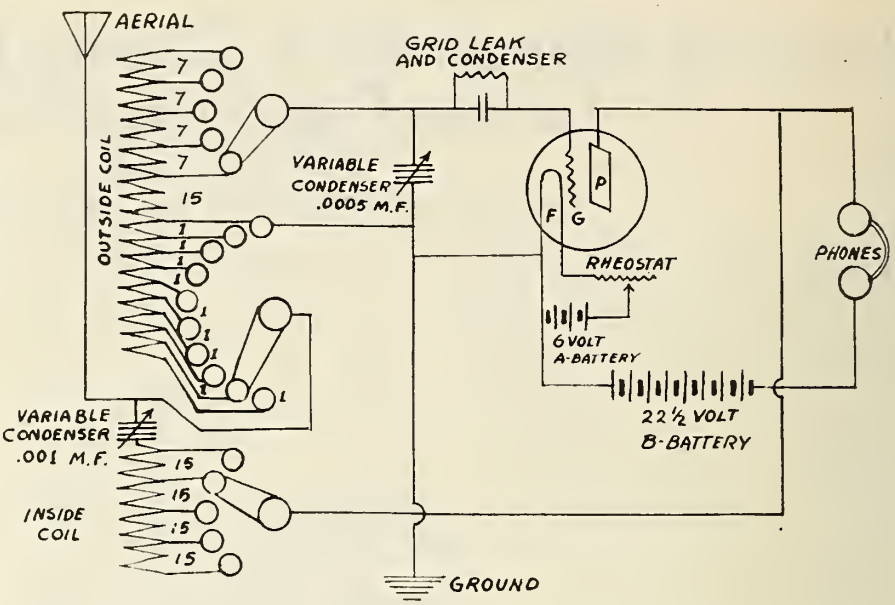


FIGURE 3

Amplification for Reinartz Tuner.

Figure 4 shows the method of adding one step of amplification to the Reinartz tuner. In this circuit a variable condenser is shown in place of the grid-leak and condenser. The use of either of these is optional with the builder. The variable condenser will give better tuning effects, but the set will work very well if the grid-leak and fixed condenser is used; in fact, the set from which these specifications were taken used the fixed condenser and grid-leak. The method of connecting the amplifier to the circuit is similar to that of the ordinary circuit. The head phones are removed from the circuit shown in Figure 3 and replaced with the primary winding of a ten to one ratio audio amplifying transformer. In the set from which these specifications were taken, this primary winding of the transformer furnished enough reactance to make the tube oscillate properly, but this is not always the case. If it is found that the filament has to be burned at a dangerous degree of brilliancy to produce the oscillations, then an extra inductance should be inserted in the circuit at the point marked "X" in Figure 4. If however, the tube is found to oscillate without crowding the filament, then this extra inductance "X" should not be inserted.

If it is found that the inductance is necessary it can be made by making a small form similar to the one on which the two coils are wound, but much smaller, and winding six turns of wire of the same size as that used on the large coil. This has been found by experiment to be the correct number of turns and should not be changed. The secondary of the trasnformer is connected to the grid and filament circuit as shown in Figure 4.

The circuit shows only one set of "B" batteries used for both the detector and amplifier tube plates, but stronger signals may be obtained by adding another twenty-two and one-half volt "B" battery between the head phones and the battery shown on the drawing. This is shown in Figure 6. It is absolutely necessary to see that the positive side of the "B" battery is connected to the part of the circuit, which eventually gets to the plate, and the negative side must always be connected to the filament. Another important thing is to see that the rotating part of the condenser "C" is connected to the aerial, and that the rotating part of condenser "D" is connected to the earth. The set will not give good results unless this is done.

The connections to the aerial, ground, and batteries are taken out through the back of the case, to avoid using binding posts on the front of the panel, as this always makes an unsightly wiring job. If desired, however, binding posts can be put on the ends of the case and all connections taken from there, but if holes are drilled in the back of the box and hard rubber, or porcelain bushings are inserted for the wires to pass through, it will make a very neat looking job. The panel for the controls is best of bakelite, or hard rubber one-eighth of an

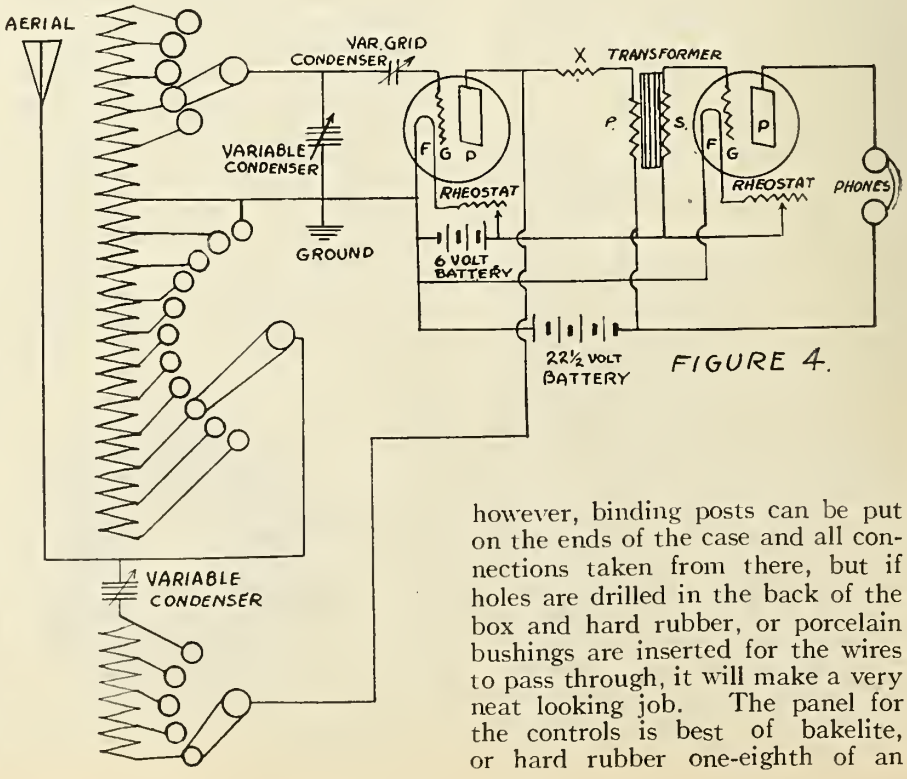


FIGURE 4.

inch thick, eighteen inches long and eight inches high. The sockets and tubes are mounted directly behind the controlling rheostats and the holes in the panel shown above the rheostats are for the purpose of watching the brilliancy of the tube filaments.

The two dials shown are used for the purpose of adjusting the variable condensers and if a variable condenser is used in place of the fixed condenser and grid-leak, then another dial must be used for this purpose and the arrangement of the panel will have to be altered to suit the case. The spider-webb coil is mounted as far back in the box as possible and is placed directly behind the switches to facilitate the connections. The addition of this amplifier will make a wonderful addition to the set, but if it is desired to carry the amplification farther, another step of audio frequency amplification may be added.

Addition of the Second Step of Amplification.

Figure 6 shows the method of adding two steps of audio frequency amplification to the Reinartz tuner. While this addition is very seldom necessary, still there are some fans who can not get signals too loud to suit them and this circuit is shown for the benefit of those who want to go the limit. When I say limit, I think I have found a good word, for this is about as far as the amplification can go with this set without injury to the receivers, or loud speakers.

The diagram shown in this figure will be clearly understood without going into details, if the reader has carefully followed through the preceding circuits. The only changes shown are in the addition of the second step, and the addition of two more "B" batteries of twenty-two and one-half volts each. These batteries must be connected in such a way that the positive of one of them connects to the negative of the next, etc. This is clearly shown in the diagram. If a loud speaker is to be used in any of the circuits, it is placed where the receiver is shown in the different diagrams. The transformers used may be of the ordinary audio frequency type, the one used in the first step to be a ten to one ratio, while that used in the second step is a three or three and one-half to one ratio. Any one of these circuits will give great satisfaction to the user and with a little patience and care in adjusting he should have no trouble in receiving signals from 1,500 miles in the winter time.

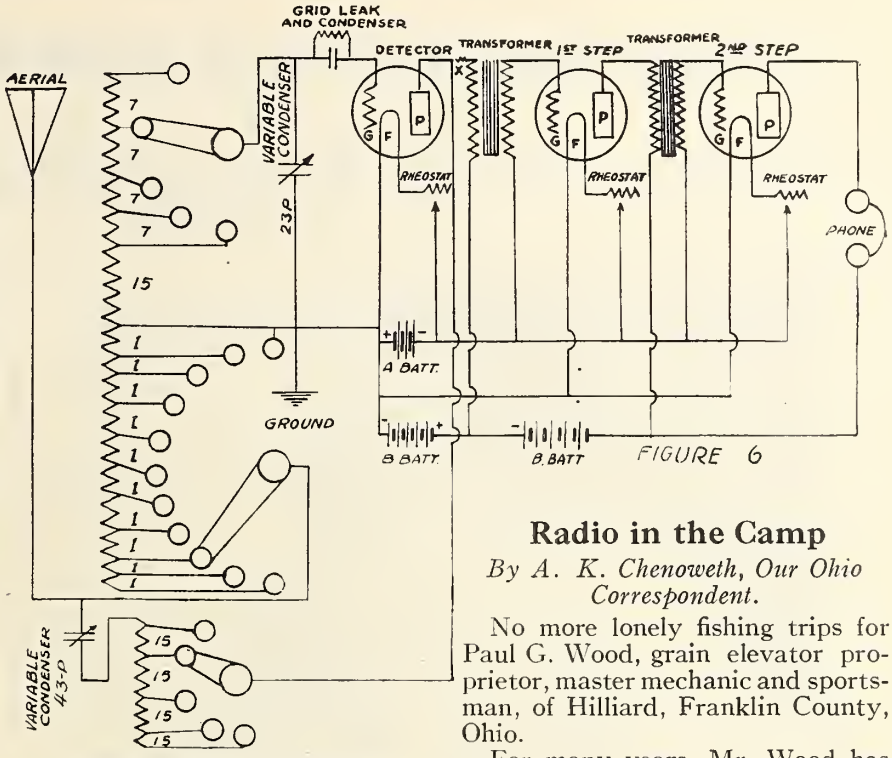


FIGURE 6

Making Switchboards

There are few trades that demand as many painstaking operations as telephone switchboard installing, the intricacies of which are well illustrated in an analysis of the work just completed on the Lexington Exchange, the newest of New York's central offices. Before the switchboard was declared ready for service, the Western Electric installers on the job were forced to make 619,082 soldered connections. In the task of making the wiring connections in the installation, they used 236,616 feet of telephone cable, which contained 8,858,450 feet of copper wire.

Toledo Is Optimistic

Interest in radio, which had fallen off during the summer months is reviving, local dealers report. A. J. Gogel, president of the Toledo Radio Club and manager of the radio department of the Athletic Supply Co., says the change in weather conditions as fall approaches and the fact that different stations are increasing their power of sending are two causes for the reviving interest.

"In the last two weeks," he says, "unusual distances have been reached. One Toledo doctor who sits up nearly every evening until 12 and 1 o'clock listening in on the different stations reports that in one night he heard Memphis, Atlanta, Kansas City, St. Louis, Chicago, Toledo, Detroit and Dubuque, Ia.

Send $1.00 to Radio Age, 64 Randolph Street, Chicago, and receive this middle-west radio periodical for six months. Regular subscription price is $2.50 a year. Thus you will be getting two months free.

Radio in the Camp

By A. K. Chenoweth, Our Ohio Correspondent.

No more lonely fishing trips for Paul G. Wood, grain elevator proprietor, master mechanic and sportsman, of Hilliard, Franklin County, Ohio.

For many years, Mr. Wood has spent his week ends and vacation times in a shack some twenty miles from his home, on the banks of a stream running through several Central Ohio counties.

When the radio first reached this section, Mr. Wood installed one of the largest and most elaborate sets at his grain plant. He secures the market reports each day and in addition tunes in on all of the available stations for concerts, programs, etc. His plant is by far the most popular place in the village and his business in side-lines, including seeds, feeds, coal, etc., has been doubled.

Each week end, when he goes to his camp, he loads the radio receiving outfit into his auto and in place of a talking machine, or bothersome companions, he goes it alone, with his radio.

Reaching camp and setting his lines for the night, he connects the machine with the aerials already in place and while waiting for the fish to bite, he enjoys concerts, speeches, solos, etc. When he is ready for sleep, he tunes in on one of the bed-time stories—and passes on to slumberland.

Sunday morning, after running his lines and eating breakfast, Mr. Wood tunes in on one of the wonderful sermons, and while courting Mother Nature, keeps his spiritual being in tune with the day.

In the afternoon, the instrument is tuned to receive a sacred concert and in the evening he again listens in on one of the main broadcasting stations.

First International Radio Congress

Celebrities of Electrical World Assemble at Pageant of Progress in Chicago

THE International Radio Congress, which assembled in Chicago on August 6, 7 and 8, as a feature of the Pageant of Progress, produced sessions that were as interesting and as important as any radio conferences held since wireless began to sweep the country. Leaders in electrical invention assembled from all parts of the country and exchanged view in public meetings on the Municipal Pier.

So successful was the congress that resolutions were passed at the closing session favoring an annual congress. At a banquet at the Electric Club of Chicago on the evening of August 8 promises were made by the national leaders in the radio world that they would give their personal presence and support to such an annual conference.

In other columns of this issue of Radio Age are published the fullest extracts from addresses made by Charles P. Steinmetz and Guglielmo Marconi. The latter's brief paper was read by Mr. Clark of the Radio Corporation, as the distinguished inventor could not attend the sessions in person.

Guests at the banquet were: Dr. Charles P. Steinmetz, chief consulting engineer of the General Electric Company; Maj.-Gen. Geo. O. Squier and Maj. J. O. Mauborgne of the United States Signal Corps; Lieut.-Col. Louis R.Krumm and Samuel Kintner of the Westinghouse Electric and Manufacturing Company; Dr. H. W. Nichols, John Mills and R. E. Heising of the Western Electric Company; Dr. Louis Cohen, Dr. J. H. Dellinger and Francis W. Dunmore of the United States Bureau of Standards; George H. Clark of the Radio Corporation of America; Benjamin Miessner, former expert of the United States Navy, and H. H. G. Mathews of the American Radio Relay League.

The contribution of Chicago men to the progress of radio was illustrated by the personnel of a group of experts, which the Western Electric Company sent to deliver important messages at the congress.

Two of these men particularly are Chicago products.

Perhaps the best known is John Mills, one of America's leading electrical engineers and author of several technical books dealing with the development of the present system of radio and telephonic communication. He spoke on "The Human Voice and Its Electrical Transmission."

Mr. Mills was born and educated in Chicago, graduating in 1901 from the University of Chicago. He studied as a graduate of Chicago at the University of Nebraska, and later at the Massachusetts Institute of Technology. He was an instructor in physics and electrical engineering for some years at the Western Reserve University of Cleveland and at Colorado College.

Early last spring the world awakened one morning to learn that the captain of the steamship America, 400 miles at sea, had conversed with the President of the American Telephone and Telegraph Company at his home in New Canaan, Conn., by radio telephone. This demonstration was largely the outcome of work carried on by the Western Electric Company engineering staff under the supervision of H. W. Nichols, a 56-year-old research physicist.

Nichols received his bachelor of science degree from Armour institute in 1908. A year later he received a degree as master of science from the University of Chicago. He returned to Armour and after two years earned his degree as an electrical engineer. Later he was awarded the degree of doctor of philosophy by the University of Chicago. To continue his work he then accepted an assistant professorship in electrical engineering at Armour institute.

"Radio telephony is obviously the only way of transmitting speech to and from ships at sea, aeroplanes in flight and isolated points such as rock-bound lighthouses or isolated ranches where wire communication involves a prohibitive expense," said Dr. Nichols. "It is also peculiarly fitted for the broadcasting of news, entertainment and instruction.

"In California the radio telephone has been connected successfully to the wire telephone circuits and the Bell system has in operation a com-

(Continued on page 10.)

International Radio Congress

August 7.

Opening remarks by the president of the Radio Congress. Maj. J. O. Mauborgne, signal officer of the 6th Army Corps Area.

Benj. Miessner on "A Secrecy System in Radio Communication."

Samuel M. Kitner, general radio engineer, research dept. of the Westinghouse Electric and Mfg. Company on "The Technique of Broadcasting."

John Mills, research engineer of the Western Electric Company, on "The Human Voice and Its Electrical Transmission," illustrated by motion pictures.

Louis Cohen, consulting engineer Signal Corps. U. S. Army, Washington, D. C., on "Wired Wireless and Its Application to Broadcasting on Power Lines."

R. E. Heising, research engineer of the Western Electric Company, on "How Speech Is Carried."

Dr. J. H. Dellinger, physicist in charge of radio laboratory of the bureau of standards, Washington, D. C., on "The Interference Problem in Radio Telephony."

Senator Guglielmo Marconi on "Radio Telephony," illustrated by lantern slides. Because of urgent business matters, Senator Marconi sailed for home on July 8, but authorized George Clark of the Radio Corporation of America to deliver his paper.

Discussion

August 8.

R. H. G. Matthews, central division manager of the American Radio Relay league, on "Amateur Radio."

Lieut.-Col. Louis R. Krumm, superintendent of radio operations of the Westinghouse Electric and Manufacturing Company, on "Broadcasting Operations, present, and Future."

Dr. H. W. Nichols, Research engineer of the Western Electric Company, on "Radio Communication."

Francis W. Dunmore, radio laboratory bureau of standards, Washington, D. C., on "A Relay Recorder for Remote Control by Radio."

Maj.-Gen. George O. Squier, chief signal officer U. S. army, Washington, D. C., will speak on a subject concerning "Line Radio" provided official duties do not accidentally prevent attendance.

Dr. Charles P. Steinmetz, chief consulting engineer of the General Electric Company, on "The Problem of Radio Power Transmission." Discussion. Report of Radio Committee, Pageant of Progress. George E. Carlson, chairman.

Problem of Radio Power Transmission

By CHARLES P. STEINMETZ
Chief Consulting Engineer, General Electric Company

(Address delivered at International Radio Congress, Chicago)

THE successful development of radio communication by telegraph and telephone raises the question of the possibility, or impossibility, of radio power transmission.

In some respects, radio power transmission exists today, for the message which you receive by radio has been carried by the power of the electro-magnetic wave from the sending to the receiving station. However, while the sending station sends out electro-magnetic waves of a power of several kilowatts, or even hundreds of kilowatts, this power scatters in all directions, and it may be only a fraction of a milliwatt, which we receive, that is, less than a millionth of the power sent out. But this small power is sufficient, when amplified, to give us the message.

The problem of power transmission essentially differs from that of the transmission for communication, that in power transmission most, or at least a large part of the power, sent out by the generating station, must arrive at the receiving station, to make it economical to transmit the power.

Hence, the problem of radio power transmission is that of directing the radio waves so closely that a large part of their power remains together so as to be picked up by the receiving station. Much successful work has been done in directing radio waves, and for instance our Transatlantic stations send out most of their power Eastwards. But still even as directed the power scatters over the coasts of Europe from Norway to Spain, so that it is impossible to pick up an appreciable part of it.

DR. CHARLES P. STEINMETZ

The limits of impossibility of concentrating a beam of radio waves may be illustrated by comparison with a beam of light. Light is an electro-magnetic wave, differing from the radio wave merely by having a wave length many million times shorter. While usually the light scatters in all directions, like the wireless wave, we can direct it in a concentrated beam by the searchlight. But there is inevitably a scattering of the light in the searchlight beam, and when the beam starts perhaps with a square-yard section at the searchlight mirror, at 10 miles distance it has at the very best scattered to a diameter of 2,000 feet, and at 100 miles distance the beams cover a section of 16 square miles. If it were a beam of radio power, it would thus require at 100 miles distance a receiving station covering 16 square miles—about four miles wide and, what is still more difficult, four miles high, to pick up a large part of the power.

The cause of this scattering is two-fold. First, the inevitable imperfections of any apparatus. No matter how perfect a reflector, there are slight imperfections, and at 100 miles distance, they seriously count. Furthermore, even with an absolutely perfect reflector the beam of light would stay together only if the light came from a mathematical point. As it must, however, come from a small area, this causes an inevitable scattering, which at best gives an angle of scattering of about two degrees. This is about 100 times as much as would be permissible to economically transmit power a hundred

miles by a direct radio beam.

Thus the probability of power transmission by directed radio is very small, except perhaps in very special cases, where the distances are moderate and the efficiency of transmission of secondary importance.

The second possibility of radio power transmission—at least theoretically—is by resonant vibrations or standing waves. Suppose we had a very large sending station sending out electro-magnetic waves not of hundreds, but of hundred thousands or millions of kilowatts, and suppose we could find a wave length, where the absorption in the passage of the wave through space is sufficiently small so as to be negligible compared with the amount of power.

Assuming first there were no receiving stations. Then the waves issuing from the sending station would circle the globe and return to the sending station, and if the wave length is adjusted so that the return wave coincides with the outgoing wave, it would return its power, and little power would be required from the sending station to maintain such a system of high power standing waves—only enough to supply the losses—just as little power is required in an electric wire transmission system, to maintain the voltage wave, as long as no current is taken off.

Suppose now we erect a second station, tuned for the same wave length as the sending station. It would resonate with the standing electro-magnetic wave issuing from the sending station, thereby stop its passage by absorbing its energy. It would, as we may say, punch a hole in the standing wave sheet coming from the sending station. Power would then flow into this hole; the sending station would begin to send out additional power to maintain the wave sheet, and this power would be received by the receiving station. This would give a real radio power transmission.

Any receiving station of suitable design would then be able to pick up power from the universal power supply carried by the standing wave sheet covering the earth. Also, several sending stations may send out power. These may either have different wave lengths, then would not interfere, and the receiving station could be tuned to receive power from any of the generating stations. Or—what would be preferable—all the generating stations would be tuned to the same wave length, that is, the same frequency. Then they would have to be synchronized and operate in synchronism, just as different electric generating stations on the same transmission line are operated in synchronism.

Theoretically, this is an interesting speculation, but whether it could ever become a possibility, would depend on the question, whether a radio wave of such length could be found, as to make the losses of power by absorption, etc., economically permissible, and whether stations for such wave length and power would be economically feasible. Furthermore, it would have to be an international development. Therefore, even if such radio transmission by a stationary electro-magnetic wave sheet were possible, its realization at best is rather distant, so that the present outlook for radio power transmission is very remote. I thought it of interest, however, to bring this before you as an interesting speculation of future possibilities.

(Continued from page 8.)

bined wire and radio system at Catalina Island. Ship-to-shore radio telephone has been worked out quite thoroughly and it is now possible to call up on the telephone and talk to a properly equipped ship from almost any point in the United States.

"In a congested district such as our large cities, however, an analysis of the number of simultaneous telephone conversations that can be carried on in a restricted area shows that the radio cannot compete with the wire telephone.

"In justice to the requirements of special services which can be performed only by the radio, such as broadcasting in the cities and special transmission of various classes in the more remote regions, it is probable that future practice and possibly future legislation will tend to restrict radio telephony to those fields which cannot be served by the wire system."

Major J. O. Mauborgne was elected president for another year on motion of Commissioner George E. Carlson of the department of gas and electricity, and empowered to appoint a Ways and Means Committee, and minor committees to prepare for next year's congress.

The Radio Club of Illinois gave a luncheon and reception in honor of Maj. Gen. George O. Squier and Charles P. Steinmetz at their clubrooms at 16 West Ontario Street.

New Rectigon for Charging Batteries

A new type of rectigon known as the "Radio-Type" rectigon, designed primarily to charge 11- or 12-cell plate batteries, such as are used for radio receiving sets, but also suitable for charging 3-cell filament batteries or 3- and 6-cell automobile starting and lighting batteries, is being manufactured by the Westinghouse Electric & Manufacuring Company.

This type of rectigon is similar to the private garage type, being portable, well finished, automatic in operation, and free from oil and grease. Although primarily designed to charge 11- or 12-cell batteries at 0.2 amperes, it is supplied with a tap in the transformer winding which makes it possible to charge 3-cell batteries at 2 amperes and 6-cell batteries at 1-1/2 amperes.

At the top of the transformer is a fuse block which is so arranged that, when the fuse is in the extreme left position, the rectigon will charge an 11- or 12-cell battery and, when the fuse is at the right, will charge a 3- or 6-cell battery. Since only one fuse can be inserted at one time, there is no possibility of an incorrect connection.

After the fuse is in the proper position, the rectigon can be started by clasping the battery clips over the terminals on the battery and turning on the current at the lamp socket. To stop charging, the current is turned off and the battery is disconnected.

The cost of operation of this rectigon is very low, being about 1/2 cent a kilowatt-hour. The bulbs have a long life and need to be changed only at very infrequent intervals.

Iowa University Busy

Extensive equipment is to be added to the broadcasting station of the State University of Iowa at Iowa City. Professor A. H. Ford, of the College of Applied Science, will give a three-hour course in the subject of radio science during the coming year.

The university will continue the operation of its wireless telegraph station which has functioned in the past as a means of relaying results of football games, other sports, weather reports and so forth.

The call letters of the university's radio-telephone station will be WHAA. The wireless telegraph call will be 9YA as it has been in the past.

Send $1.00 to Radio Age, 64 Randolph Street, Chicago, and receive this middle-west radio periodical for six months. Regular subscription price is $2.50 a year. Thus you will be getting two months free.

Vaugh MacCaughey, head of Hawaiian public schools, is arranging to install standard receiving sets in all rural schools. Extension courses, especially in agriculture, will be broadcasted from the University of Hawaii.

Marconi Discusses "Short Waves"

Italian Genius Writes Paper for Chicago Radio Congress

URGENT business compelled Senator Gugliemo Marconi to return to Italy before the International Radio Congress, in connection with the Pageant of Progress, Chicago, August 7 and 8, He prepared the following paper, however, and it was read by George H. Clark, of the Radio Corporation of America:

"Since the beginning of radio activities, the wave lengths have been getting longer and longer and in every case non-directive, or "broadcast" transmission has been used; that is, the radio signals have been radiated in all directions into space, that one particular receiving station out of the millions of possible receivers may gather in the signal. Only in the last year, when broadcasting of general information has become popular, has the 'radial' feature of modern radio communication really been utilized at all.

"One of the reasons that short waves have been neglected so long is that there is far greater 'fading' experienced with their use. That is, signals might be extremely strong at one moment and the next moment might die to inaudibility, a characteristic which is by no means so marked when the wave length is made greater.

"It has long been appreciated that, apart from fading, short waves were much more efficient than long, as, for instance, the recent achievement of American amateurs in reaching England with only a few hundred watts on a short wave length, whereas commercial stations on wave lengths hundreds of times longer must use powers of several hundred kilowatts.

"The point to be noted here, however, is that the amateurs happened to 'get through' once, out of thousands of times of failure, and succeeded that once because 'absorption' or 'fading' happened to be noticeably absent for a brief period, whereas the commercial stations get through practically all the time.

Power Is Concentrated.

"Now, directional transmission offers a further possibility for getting messages through with low power because all the power that is available is concentrated over a few degrees of arc rather than sent, uselessly, in every direction in order to be utilized in one only. Directional transmission,moreover,means reflection of the created energy by local reflectors so as to catch and send back energy that otherwise would go in the wrong direction, and since reflectors must have comparable dimensions to their reflected waves, it is not today practicable to reflect wave lengths of thousands of meters in length. But with waves of fifty meters it is another question. Directional transmission, therefore, is possible on short wave lengths.

"Direction reception, or picking up a message that is coming from one given direction and not picking up others from sources of different location, has been with us for some time, so that we can directly make use of this for the new development of radio.

"We have, therefore, the long-known fact that short waves, per se, are ideal from the standpoint of energy; we have the possibility of directing these waves in one direction; we can also sharpen the eyes of our receiver so it is blind in all but one direction and especially keen in that one. There still remains the problem of the intermediate absorption.

"Distances of fifty miles have been reached already on this short wave directive work, using radiotelephony, and experiments on far greater powers are now in progress.

"A further application of this directive transmission is in the establishment of 'radio lighthouses.' A radio transmitter is rotated constantly, sending out therefore a beam of radio waves just as a lighthouse sends out a beam of light. A different Morse character is sent out automatically for every major position of the beam around a circle, and by this means a ship can tell exactly her position with respect to the lighthouse. This is being tried out in England now under practical conditions."

News of the Anti-Static War

THE battle against static goes merrily on and it appears that those who aim to thwart the atmospheric disturbances hope to do so in widely different ways. One experimenter tries the underground aerials, another pins his faith to outside perpendiculars loops, and still another use, the horizontal outside antennae with startling methods as to length.

An antenna designed to eliminate static interference, nine miles in length, has been installed at the chief receiving station of the Radio Corporation of America at Riverhead, L. I. The aerial is supported on poles, thirty feet above the ground. One end is grounded through a non-inductive resistance and the other through a variable inductance. With the antenna the station is receiving European stations operating on 15,000 meters, or in other words, electro-magnetic waves, each approximately nine miles in length.

In explanation of the principles employed in the use of the large aerial, P. H. Boucheron of the Radio corporation furnished the following analogy:

"If we look upon the new antenna as a large lake and the wind as the static, we can get an idea how it works. Now, suppose the wind is blowing across the lake from east to west. At the eastern end there will be few or no ripples, but as we get to the western end the ripples will gradually increase in size to full waves. If the shore at the western end is a gentle slope of sandy gravel, the waves will be dissipated.

"If, on the other hand, the shore is precipitous the waves will be reflected and will disturb the eastern end of the lake. Now this antenna, having a non-inductive resistance at its non-receiving end, corresponds to a sandy shore, because it absorbs the static and interfering waves and does not reflect them.

"Carrying the analogy further,

if we place a stationary paddle wheel at the western end of the lake, which is revolving uniformly and producing waves of a uniform character, these waves will travel steadily forward toward the eastern end and will not be interrupted by or stopped by the wind. This paddle wheel corresponds with the transmitting station and the waves it sends out are equivalent to the waves from the European station.

"The tests which have been conducted at Riverhead completely confirm this theory. When the receiving apparatus is placed at the end, which is graduated through the non-inductive resistance, it is impossible to hear anything but a terrific roar due to continuous static discharge. Using the wire properly as 'wave' antenna, trans-Atlantic wireless communication can be carried on without any difficulty, despite the static."

This antenna system can not be carried out by the amateurs because of lack of space, but the system suggests many promising methods which radio engineers are busy on and hope to solve this problem of remedying, if not eliminating, static in the radiophone broadcast entertainment.

As the result of experiments conducted by the radio section of the postoffice department, announcement is made that the day of the aerial is over. The elimination of the aerial antenna is incidental to experiments conducted by the department in an attempt to limit or eliminate static interference.

The following description of the tests conducted has been made by James C. Edgerton, superintendent of the radio section:

"The air mail radio section has eliminated the use of regular transmitting antenna for receiving purposes altogether, as it has been found that the static conditions prevalent especially in the Middle West made receiving impossible. Results have been obtained, however, through the use of three different methods of receiving, which are selected to conform to local conditions. There are large vertical outside multiple turn loops, secondly underground horizontal loops and lastly underground antenna.

"The best results are obtained with the underground antenna when it can be laid in damp soil with a straight away of 1,000 feet. The horizontal buried loop is more or less of a new departure and has been very successful when well insulated and buried in water or very damp earth.

"In actual use well-constructed underground antenna such as are used in the majority of the fifteen stations in the air mail circuit, the results are rather unusual. Communication has been carried on in the Middle West between air mail stations when lightning was actually striking nearby. As a matter of fact it has been possible to carry on communication when the currents induced in the antenna from nearby lightning discharges blew out the arc. Receiving on an ordinary antenna would have, of course, been impossible long before the storm reached the vicinity."

Gas an Ally of Radio

Gas is an important factor in the manufacture of telephone apparatus. The heat required in the production of the delicate apparatus used in the communication systems of the world and in radio broadcasting equipment makes necessary two of the largest privately operated gas tanks in the country. They are owned by the Western Electric Company, which in its manufacturing plant at Chicago, uses daily enough gas to supply a city of from 80,000 to 100,000 inhabitants. This immense amount of gas is consumed entirely in productive operations requiring exceptionally high temperatures, none whatever being used for generating power or for heating buildings.

The applications of gas in telephone and radio telephone manufacturing are many and diversified. It heats the large ovens in the foundries, it softens the glass used to make switchboard lamps and vacuum tubes, it heats the lead presses which put the heavy lead coating around miles and miles of telephone cable every day, it softens iron in the annealing ovens and hardens it in the tempering ovens, it heats beakers and crucibles in the chemical laboratory and it performs a thousand and one other tasks in the big works.

The Chicago gas plant is operated twenty-four hours a day in three eight-hour shifts ,and is equipped to send out 135,000 cubic feet of gas an hour under peak-load conditions. The usual maximum is about 105,000 cubic feet an hour, and at times the output reaches one and a half million cubic feet per day.

Send $1.00 to Radio Age, 64 Randolph Street, Chicago, and receive this middle-west radio periodical for six months. Regular subscription price is $2.50 a year. Thus you will be getting two months free.

Chicago District Leads

Growth in code interest among amateurs is best measured, according to officials, by the increased number of licensed amateurs within the last year, and by indications of a consistent increase for some time to come.

Every receiving set represents a potential transmitting set, officials believe, especially where the owner is a boy with a scientific mind, and every encouragement is being given to that boy in the way of helping him to get an operator's license. Incidentally, when the new radio law is enacted, most licenses to amateurs will be granted for code transmission only, it is understood.

The following detailed tabulation of the number of licenses by each Federal radio inspection district will give some idea of the trend of radio, especially of the growth of interest in code transmission. The figures are for the year ended June 30, 1921, and for the year ended June 30, 1922:

	1921	1922
1st Dist., Boston, Mass.	2083	2490
2d Dist., New York City	2063	2336
3d Dist., Baltimore, Md.	991	1863
4th Dist., Savannah, Ga.	206	342
5th Dist., New Orleans, La.	425	740
6th Dist., San Francisco, Cal.	1255	1685
7th Dist., Seattle, Wash.	513	752
8th Dist., Detroit, Mich.	1463	2635
9th Dist., Chicago, Ill.	1761	3030
Totals	10759	15873

The difference between the two totals reveals that 5,114 new licenses have been granted during the year just ended.

Atlanta Journal's Record

Only six left now.

Dixie's greatest radio station, WSB, has been heard in forty-two states of the Union, leaving exactly a half dozen Rocky Mountain and Pacific Coast States as the only parts of the country where "The Voice of the South" has not carried southern music and southern messages.

H. S. Wiggers, of the Pacific Electric Company, Sheridan, Wyoming, writes The Journal radio department that he not only heard one of WSB's 10:45 concerts, but that he heard it so clearly and enjoyably that he put it through a oud speaker for the benefit of a group of friends.

Colorado reported hearing WSB's call for the second time in the same mail that bought the Wyoming letter. J. F. Schwartz, lumber dealer, of Estes Park, Colo., in the mountains north of Denver, was the listener.—[Atlanta Journal.

Anything involving mechanics interests the Japanese. They are imitators, rather than initiators, along mechanical and scientific lines. Japan, being a warlike country, protects carefully its various means of domestic and foreign communication. For this reason alone, the Japanese are not permitted to play with radio, as Americans are privileged to do. But there is a big plant in Tokyo called the Nippon Electric Co. which is a subsidiary of the Western Electric Co. The picture shows the employes of this concern, dressed in grotesque costumes and playing a Japanese game.

Who Saw the Broadcasting Vision?

Harry Phillips Davis, Was the First Man to Foresee the Popular Appeal of Radio

"FRANK, I'm going to close your station."

Paradoxical as the statement may seem, this was the actual start of radio broadcasting as we now know it. The concerts on regular schedules, advance programs, entertainment in the air, all came from closing "Frank's station" and opening KDKA, the first radiophone station in the world.

For "Frank" was Frank Conrad, assistant chief engineer of the Westinghouse Company, and the man who made the statement was Harry Phillips Davis, Vice President of the Westinghouse Company.

Mr. Davis had come into his office that morning in September, 1920, with an idea. The idea had come to him while reading the advertisement in his evening paper. In a corner of a full page ad, he came across the words, "Mr. Conrad will send out phonograph records this evening." This advertisement was in the interest of the store's amateur radio department and was explaining to local radio amateurs that Mr. Frank Conrad, who had operated his station intermittently since the war, would send out by radio, phonograph records on a certain evening. The Conrad station was very well-known to amateurs all over the country, for it was one of the new amateur stations licensed to operate during the war. This special operating was in the interests of government research work, which the Westinghouse Company was doing, and also to test some apparatus.

Mr. Davis could not forget his idea. He was struck with the fact that the radiophone fundamentally did not lend itself only to private communication but that it had a universal field of usefulness and that through it, one could communicate to hundreds, thousands or millions; all could listen who had the suitable "ear," for if a certain class of people were interested enough to listen to music from a few records there was a possibility of increasing this small audience of radio listeners to an enormous number by sending out entertainments, current events, etc., in a regular and interesting manner. Why confine one's audience to a small portion of the country? Why not build a big station and let everyone, who wanted to, hear? Why not make radio broadcasting a public service?

Mr. Davis was so struck with his idea of a public broadcasting service that the first thing he said to his

Secretary on entering his office next morning was "ask Frank to come in."

"Frank," as has been previously explained, was Mr. Conrad, who having been taken so abruptly with his chief's statement, could only listen to what followed.

"Frank, my idea is that you stop sending from your station and we will start a regular service from our experimental station here at East Pittsburgh. We can arrange for a suitable wave length, and I believe if we do this, it will be the beginning of a radio broadcasting public service which seems to me to have wonderful possibilities."

The conference with Mr. Conrad lasted a short time and Mr. Davis called other conferences before actual work on the broadcasting started. It was not until November 11, 1920, that KDKA was formally opened with the broadcasting of election returns.

The remainder of the history of KDKA is now common property. Everyone, almost, now knows that there are more than 200 broadcasting stations in the United States and that the radio audience numbers into the millions each night.

Not everyone knows, that it was a single line in a newspaper which suggested to the Vice President of one of the largest electrical manufacturing companies in the world, the big thing of turning a scientific novelty into a new kind of public service by unfolding a new field of communication.

Mr. Davis was one of the best equipped men in the electrical industry to take up the difficult problems of broadcasting. He has been a leader in the electrical industry since his college days, and has been issued nearly 100 patents covering electrical apparatus. He is an engineering genius and is known, not only as a designing engineer of high rank, but also as a man who gets things done. His ability to accomplish results rapidly has already been proved in the history of his company's broadcasting achievements. This ability was also admirably illustrated during the war. He was, at that time, in charge of production at the East Pittsburgh Works and the duty of fulfilling the government contracts for munitions was his. Probably no more colossal manufacturing task was ever given anyone. The quantities involved were enormous; the time limits short; the specifications most rigid; new and undreamed of problems arose at every step; the government's plan changed with bewildering frequency; material, competent help, and transportation facilities became almost unobtainable; and innumerable other difficulties were encountered. Yet, in spite of everything, the work was done and it was done properly and on time. Not a single promise made to the government was broken.

This is all by way of illustrating the character of the man who first saw that radio broadcasting was something that held greater possibilities than just being the plaything of the amateur.

Mr. Davis was born at Somersworth, New Hampshire. He was graduated from the Worchester Polytechnic Institute with the degree of B. S. in Electrical Engineering in 1890, and after a trip to Europe and a few months spent with the Thompson-Houston Company, entered the Detail Engineering Department of the Westinghouse Company in 1891. In 1896 he was placed in charge of this department; in 1908 he was made manager of the Engineering Department. This position he held until 1911, when he was elected Vice President.

Mr. Heising's Genius

When the three-electrode audion or vacuum tube, the invention that made radio telephony possible, came into being along in 1912, it set to working the mental machinery of Reginald A. Heising, a young physicist, working for a degree as Master of Science in the University of Wisconsin.

"If I could put into a vacuum tube the amount of energy produced by the voice and get it out many times amplified in the form of high frequency power in an antenna, what an advance it would be," thought this young scientist.

Armed with his degree he went to work on this problem in the research laboratories of the Bell System operated by the Western Electric Company. Six weeks after he started, his first patent, establishing the basic principle of the Heising modulation system, was applied for. Since that time he has been engaged in perfecting the discovery. How well he has solved the problem was proved by the award in 1921 to him of the Morris Liebmann memorial prize by the Institute of Radio Engineers. This is the highest tribute which the radio fraternity can bestow upon a fellow scientist.

In the communication field today the Heising system of modulation is a fundamental law and the young inventor whose work in research brought it about holds an enviable position in the world of scientific achievement.

Farm Wives Made Happy

By A. K. Chenoweth, Our Ohio Correspondent.

The radio threatens seriously one of the greatest sources of enjoyment for years of the country women of Central Ohio, following the installation recently of several radio receiving sets in one neighborhood.

There was a time when the old-fashioned telephone party-line held fast the hearts of the country women—but it's not so today!

Radio has arrived. And the men seeking to transact business over their telephones are having the time of their lives, and getting their business deals across over the telephone with much less expenditure of labor and violations of the anti-swearing law.

The women have dropped their daily conversations over the phone with the neighbors and have taken to listening in on the news, which comes from everywhere and nowhere, as it seems. They have given up for good, they say, the habit of spending half of the morning and perhaps half of the afternoon, talking over the party-line and are now enjoying direct communication with women from all parts of the country.

Their field has been widened and although they do not get to hear the news from the cross-roads' store quite so often, or so soon, they say that the gossip from the air is much more interesting and, why, they are actually getting acquainted with many of the greatest artists in the nation.

And they do not intend to neglect their other work, it appears. The other day we saw a woman busy in her kitchen, engaged in ironing the family washing and having the time of her life with a radio receiver clamped over her ears—listening to a concert in Detroit. Later in the day, she tuned in with another broadcasting station and when her husband came in from the field, she had the latest daily market report ready for his inspection.

When our country lady goes to town for the weekly or semi-weekly visit and some of her city friends starts to "lord it over her" by telling of the wonderful new radio set she has at home, Mrs. Farmer turns her nose to the sun, and opens a regular conversation on the best from the "voices of the air." And, my, how she enjoys the chagrin of her city sister, who for so many years had ridden rough-shod, as it were, over her country relation!

Introducing K F A F

Denver's latest broadcasting station is an important one. It is K F A F, operated by the Western Radio Corporation and the Denver Post. The establishment of this station means additional programs of news and musical entertainment for fans throughout the west.

George S. Walker, owner of the Western Typewriter Sales Company, and president of the Western Radio Corporation, some time ago determined to build the best radio transmitting station between Chicago and the Pacific Coast.

He engaged Elden F. Horn, a radio veteran in Chicago research work and development, to engineer construction. George Walker, Jr., is vice president and manager of the company and Fred D. James is Secretary. Mr. Horn supervises the manufacture of radio equipment for the corporation.

The Charles E. Wells Music company has furnished the artists' studio at the big broadcasting station with a Haddorff piano and a Victrola, with an elaborate assortment of up-to-date records. The Wells Music Company will also furnish regularly a program of local song birds and musicians and occasionally players and artists of national reputation.

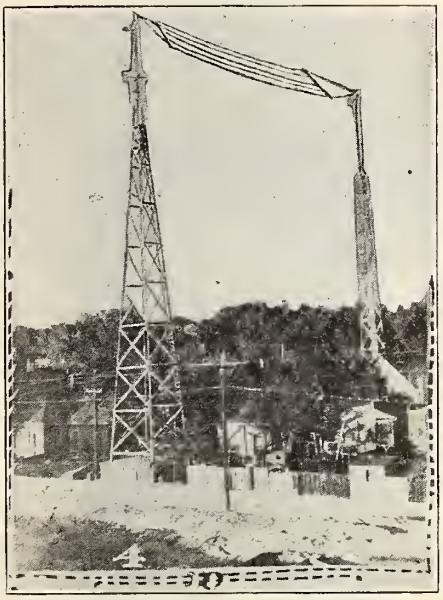
The aerial is a flat-top "T" type of six wires, supported on twenty-four-foot spreaders. The lead-in is of the cage type. The entire aerial is supported by the two towers which rear their heads 120 feet above the street.

The original construction provided for towers 140 feet high, but it was found necessary to reduce the height of the steel masts twenty feet, since it was impossible to guy the big steel superstructure to adjacent property. Heavy winds played havoc with the superstructure, and it was necessary to make repairs three times. Now the towers are self-supporting and securely guyed as well.

The station's power plant consists of a three-phase motor directly coupled to a 2,000-volt generator and an excitor furnishing current for the fields of the large machine. The broadcasting plant is equipped with one of the best wave meters available.

The studio is commodiously and elegantly furnished, and the walls are draped with heavy fabric to absorb confusing echoes, so that the voices of artists will be transmitted true to life.

Mr. Horn constructed and operated a spark station in Chicago before the days of the radio craze. His Chicago station, 9AJA, was accorded much publicity a few years ago in radio publications because of its wonderful efficiency and the great distance covered on the small power. His little station was frequently heard at points from Toronto, Canada, to Orlando, Fla., on voice transmission.



Aerial and Towers of New Denver Station

In the fall of 1921 Mr. Horn installed a 100-watt CW station, which was heard in Alaska, the canal zone, Yokohoma, Japan, Honolulu, and by ships at sea 1,700 miles east of New York, says the Denver Post. Nightly conversations with amateurs in practically every state in the union were carried on, and Mr. Horn was complimented and honored by government and other radio experts.

During the past few years Mr. Horn has also been occupied writing technical works on radio and has delivered lectures at colleges and radio conventions.

Detroit School Plans

Radio classes and classes for foreign women are two of the most interesting features of the Detroit evening school department, under the Board of Education.

The catalog of Detroit Junior College evening classes, which open September 18, announces a course in radio, at Central High School. This course consists of daily code practice, combined with frequent lectures on the theory and handling of equipment. A set which has a range of 1,000 miles and a receiving record of Germany and Japan, will be used in the study.

Big French Station

The big wireless station of the Centre Radioelectrique de Paris at Sainte Assise, France, said to be the most powerful radio in Europe, is in operation, having been officially opened on August 6. This puts New York and Paris in direct touch with each other for the first time and marks a new era in international communication.

Pressing a key at the French company's central control station at No. 79 Boulevard Haussmann, Paris, an operator flung a dot and dash message 3,000 miles and more through the air to No. 64 Broad Street, the central control of the Radio Corporation of America, as easily and quickly as one might telephone from Manhattan to Brooklyn. And the answer was shot back almost instantaneously.

As described by radio experts here, the service means a tremendous impetus to commerce by wireless across the Atlantic Ocean. With inauguration of the new company, the French government has ceased to control the radio in France and private initiative is to take the place of governmental administration.

The official opening of the station was the occasion of a number of radiograms dispatched between France and America. Chief among these were messages of congratulations and good will exchanged between President Millerand and President Harding.

Philadelphia Show

Following the exceptional successes which we met last spring in staging the radio shows at Pittsburgh and Detroit, the American Radio Exhibitors' Association are outlining a campaign for this fall and winter. Invitations have been received from cities in all sections of the country and the first to be accepted and staged will be that at Philadelphia, September 27 to 30 inclusive. This will be followed by others to be announced later.

A careful check-up on the total sales by jobbers and manufacturers alone at the Detroit show brings out the startling fact that more than two million dollars of business was transacted on the floor. This, of course, does not include the impetus given to the industry in general by the educational work which we carried on.

Send $1.00 to Radio Age, 64 Randolph Street, Chicago, and receive this middle-west radio periodical for six months. Regular subscription price is $2.50 a year. Thus you will be getting two months free.

Radio Broadcasting in Great Britain

Interview with A. P. M. FLEMING, British Electrical Expert

"GREAT Britain will solve the interference problem in radiophone broadcasting by government control and regulation," according to A. P. M. Fleming, C.B.E., manager of the research and educational department of the Metropolitan-Vickers Electrical Company, Manchester, England. Mr. Fleming represented England at the international convention of the Institute of Electrical Engineers and the International Electro-Technical Commission at Niagara Falls, just ended.

"We have learned many valuable lessons from the broadcasting experience of the United States," said Mr. Fleming after his visit to KDKA, pioneer broadcasting station of America, situated in the East Pittsburgh works of the Westinghouse Electric & Manufacturing Company. One of the things we have learned is to avoid the establishment of innumerable radio stations, with no plan of cooperation between them. Eight 1 1-2 kw. stations are contemplated and some of these will probably be built this year. These stations will be located in the principal cities throughout the British Isles and will be operated so as to eliminate the chaos usually found where no rules are in force.

"We have no such thing as broadcasting in Britain at present in the sense in which the term is used in America," he said. "Government restrictions have prevented it, on account of the possible interference with the requirements of the navy, mercantile, marine, war services and aeroplane traffic. But the largest manufacturers of radio apparatus have cooperated with the British Government officials in working out plans for the proper control of broadcasting.

"The broadcasting stations will be operated on strictly regulated wave lengths and other set rules, which will be published for the guidance of radio receiver owners. Every radio set owner will be required to pay an annual tax, also, and there will doubtless be special restrictions applying in times of national emergency.

"One thing that British manufacturers have had to do that was not necessary in America is to study out closely the cost of receiving sets. The average Britisher can afford to spend very much less than the American in purchasing apparatus of the nature of a luxury. But even with that drawback British manufacturers see a great field ahead for radio."

A. P. M. FLEMING,
English Radio Engineering Expert

Mr. Fleming, in addition to representing the Institute of Electrical Engineers of England at the Niagara Falls convention, is making a survey of radio developments in America. His survey may have considerable bearing on the regulations drawn up for government control of broadcasting in England.

His technical career is interesting. After receiving his training at the Finsbury Technical College, he spent the following year at the London Electric Supply Corporation at Deptford, and after a short period with Messrs. Elliott Brothers, Instrument Makers, he crossed the Atlantic and joined the Westinghouse Electric & Manufacturing Company at East Pittsburgh. Two years later he went to Trafford Park, so that he now completes a period of 20 years' service with the Metropolitan-Vickers Company.

For some years he was the company's insulation specialist, dealing with all investigations relating to insulation, the testing of new materials and the investigation of electrical failures. Afterwards he was appointed superintendent of the transformer department and was responsible for the design and manufacture of all the transformers turned out by the firm, totalling some millions of kilowatts. During this period he supervised the department's manufacture of insulating materials and electrical windings of all kinds. Almost from the commencement he was responsible for the training of the apprentices at Trafford Park and in 1912 he established the works' school. The capacity of this school has grown from the original number of 100 trade apprentices to 650 at the present day, and in addition to this there are about 80 public or secondary school boys and 100 university men undergoing special courses of training.

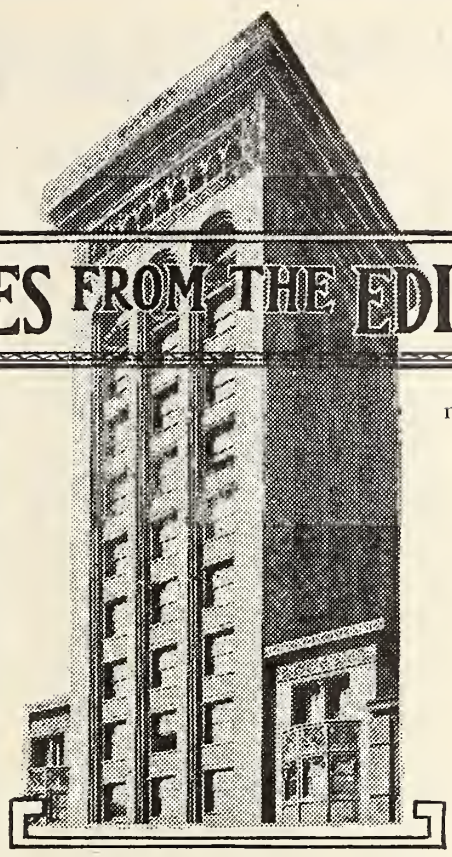
Since 1916 he has been head of the Research Organization of the company, and also of the educational and training work. The design and equipment of the extensive Research Laboratories recently built are his work.

In the midst of all these duties, Mr. Fleming has found time to produce a number of books as author or collaborator on the subjects which he has made his life work. He has also read a number of papers before the Institution of Electrical Engineers and other kindred bodies, and on matters relating to welfare work before the Welfare Workers' Institute Conference.

Radio at Legion Games

Radio will play a large part in the American Legion's athletic games to be held in Syracuse, Friday, September 22, according to an announcement just made by Bernard F. Ryan, chairman of the American Legion's New York State Athletic Committee.

"The crowds who attend these games held for the benefit of the Veterans' Mountain camp at Tupper Lake will be provided with continuous musical radio entertainments," Mr. Ryan said. "Furthermore, the results of the races and games will be announced over the loud speaking amplifying devices which will be placed at convenient points in the immense Syracuse University stadium. H. A. Peiser, of the Syracuse Radio Telephone Co., is negotiating with several other sources in New York to install a microphonic arrangement in the stadium that will enable the notables present, among them President Harding, Governor Miller, General Pershing, Judge K. M. Landis and acting Secretary of the Navy Theodore Roosevelt, to address the crowds in the stadium from their respective boxes.



THOUGHT WAVES FROM THE EDITORIAL TOWER

EARLY last spring this publication called attention of its readers to the fact that great progress in radio might be looked for in the Middle West. That was one reason why it appeared probable that the Middle West could and would support a magazine published in the Mississippi Valley and devoted extensively to radio interests 1,000 miles west of New York.

In the light of that prediction and that expressed hope it is interesting now to glance over the figures showing the growth of radio in various government inspection districts in the United States. This survey of official reports shows that the growth of interest in code transmission has been much greater in the Middle West and West than it was in the eastern districts.

For example, the first inspection district, with headquarters in Boston, issued 2,083 licenses to amateurs in the year ending June 30, 1921. At that time the first district had a larger number of licensed operators than any other district. Now the Boston district is fourth in the list. Chicago is first, with 3,030 and the Detroit district is second, with 2,635. New York shows up third, as headquarters of the second district, with 2,336.

Interest in radio has been encouraged and stimulated by the energetic and intelligent leadership of the Detroit News in the eighth district. In Chicago the excellent broadcasting programs of the Westinghouse station K Y W literally swept tens of thousands of fans into the radio game. Now there are numerous stations in Chicago and in cities throughout the rich states which comprise the ninth district. Detailed information on the license records is published elsewhere in this number.

Madison Street in Chicago has so many radio shops that it has come to be known as "Radio Row." But the title might almost as well be applied to Wells Street, north and south of Madison, as every few weeks sees additional electrical and radio stores opened in that thoroughfare.

St. Louis and Kansas City have brought Missouri into the forefront in radio activity and an impressive portion of the mail that arrives in the office of Radio Age comes from Missouri readers. After six months of very satisfactory progress this magazine is pleased that it has had the opportunity to be a part of radio progress in the Middle West and that it was privileged to grow with the growth of the Middle West interest in radio.

CABLES from London indicate that England is enjoying a wave of radio enthusiasm which appears to have prospects of permanence. It is also reported that some injury is being done to radio interest among amateurs by the flooding of the market there with inferior apparatus, chiefly from France and the United States. Not wishing England any bad luck, we are pleased to note that the bootlegging radio equipment manufacturers are seeking a foreign outlet for their wares. It will not be long before English novices will learn, just as American novices have learned, that there are various grades of radio merchandise on the shop counters and that a little care and investigation will fully protect the average buyer. Substantial manufacturers in this country who advertise their products and take pride in establishing their firm name and their trade mark at the same time they are establishing a market for their goods are very sure not to be foisting inferior stuff on the trade and on the public. It follows logically that a publisher who exploits advertisements of inferior goods is party to deception and is building nothing but lack of confidence in his publication. Frank D. Pearne, technical editor of Radio Age and director of Radio Age Institute, is prepared to answer questions as to the merits of radio apparatus offered for sale in the Chicago territory. He requests only that the necessary time be given for investigation of those sets and appliances with which he is not already familiar. Read Radio Age advertisements and send your inquiries to Radio Age Institute and you will not be bootlegged.

LOUD speakers were installed on the Municipal Pier during the Chicago Pageant of Progress. The pier is so large that many of the horns were used. One afternoon a child was separated from its parents on the great pier. The fact was communicated to the broadcasting station and within a few seconds the thousands then wandering about the pageant exhibits were listening to a description of the child and to information as to where the parents could be located when the child was found. Within another few minutes there was a happy reunion of parents and kiddie. The incident was interesting as a suggestion of what radio may do in city-wide searches for lost persons, and even for criminals, when the development of radio shall have made street corner loud speakers a common feature of big town life.

Radio instruction will be offered to the manual training classes in the Peru-LaSalle (Ill.) Township High School this year.

Radio and Motoring

It may not be commonly known that as early as August, 1919, wireless telephone sets were in use on a few automobiles. Necessarily these instruments were more or less crude, and for the purpose of experimentation, but they served as a nucleus for a quite general movement today to equip automobiles and trucks with radio as a matter of course.

This, of course, opens up a fascinating line of thought. Imagine, for example, how extraordinarily useful such equipment would prove to the trucking business. The dispatcher or owner could keep in continuous conversational touch, for the purpose of giving instructions, with all his drivers. The driver, instead of leaving his seat and telephoning to the office, if he is in town, could simply "switch on" the instrument and without delay get in touch with headquarters. If he were in trouble out on the road he in the same way could quickly communicate this fact. This and many other instances are referred to by a recent Firestone Ship-by-Truck bulletin.

The latter case is where wireless would prove extremely useful to the motorist, and while the efficient radio could not transport him any gasoline, it would soon get some on the way via service car. Imagine, too, the advantage of the salesman being able to keep in touch through this means with the home office or the touring party being able to transmit to those at home the wonders of the scenic effects they were witnessing.

The banker or other business man could keep in touch with the trend of the market, important telegrams that have arrived and how affairs at the office are progressing.

The imagination staggers under the possibilities that the radio presents and it may not be long before the car and truck owner may be able to experience this utility.—[Wallie Birmingham, in Chicago Evening Post.

County Fair Concerts

A radio concert feature will be given at the Franklin (Ohio) county fair to be held at Hilliard, north of London, on September 13, 14 and 15.

Secretary LeRoy Dobyns has announced that a receiving set is being installed at the fair grounds and that arrangements are being made with Columbus broadcasting stations to put on special programs during the afternoon and evenings of the fair.

Nauen to Be Enlarged

That famous long-distance radio station, Nauen, in Germany, is to be altered so as to increase its range and to meet the increasing traffic in the United States and Argentine Republic. Twenty-five million marks additional capital is being raised by the Trans-Radio Company, and a beginning has already been made with the constructive work. The plans include the erection of seven new masts, each 689 feet high, and the dismanteling of four of the existing masts.

Crosley's Great W L W Will Greet U. S. Fans This Month

Final touches are being applied to the new and powerful radio broadcasting station being constructed by the Crosley Manufacturing Company, Cincinnati, Ohio, and within a very few weeks the call W L W, now so well known to thousands of wireless enthusiasts, will be flashed out with power enough behind it to make it audible in every nook and corner of the United States.

The plant is being constructed by the corps of engineers employed by the Crosley Company, each member of which has had wide experience in the radio field, and the work is being done under the supervision of Charles E. Kilgour and Dorman Israel, regarded as among the most efficient wireless telephony engineers in the middle west. Powel Crosley, Jr., president and owner of the Crosley Company, has issued orders that the new station be as efficient and elaborate as any in the country, and is spending thousands of dollars that his instructions may be followed.

The old station is located in the former plant of the Crosley Company, but the new one is being constructed in the new and large factory recently taken over. This is at the corner of Colerain and Alfred streets, one of the most centrally located sections of the city of Cincinnati. The entire third floor of the plant has been turned into the radio station, and the studio and reception rooms will accommodate more than 100.

Some idea of the power behind the new plant may be obtained from the following:

Four 250 Watt radiotron tubes will be used, two as oscillators and two as modulators, with the Heising system of modulation used in connection with speech amplifier. This speech amplifier will be composed of three Western Electric No. 216 A, amplifying tubes, arranged with one connected to the microphone circuit, with its output impressed upon the other two, which will be arranged as a pushpull amplifier.

Their output is impressed on two 50 Watt Radiotrons, operated back to back, or as the push pull system, while the output of the entire amplifier is impressed upon the grids of the modulator tubes. Normal radiation will be nine amperes, using the Hartley oscillating circuit.

This set also can be operated as a master oscillator-modulating outfit, using one 50 watt tube as a master oscillator, modulated by another 50 watt tube. The high frequency output of this unit will be amplified by one 250 watt tube, and its output, in turn, amplified by three 250 watt radiotrones. Sufficient tests have not yet been made to determine which will be the better method of transmission.

The antenna is 140 feet long, with an average height of 125 feet. This is composed of twelve wires on 23 foot spreaders. The four outside wires are doubled and the lead-in is a cage one inch in diameter and made up of 768 strands of No. 30 wire. The counterpoise is 60 feet below the antenna at the lead-in end and 90 feet at the other end. This contains 15 wires on 34 foot spreaders, the four outside wires being doubled as in the case of the antenna proper.

The high voltage supply is obtained from a Glow Electric motor generator composed of two 1000 volt, 1 1-2 K W generators coupled to a five-horsepower three phase 220 volt squirrel cage motor. One 3-4 K W exciter is belted to the set and supplies 220 volts for the field excitation.

Although it may be impossible to open this new station before the middle of September, elaborate preparations already are being made for the opening night.

This concert will be started at 8 p.m. and will continue until midnight, stopping only at the necessary "stand by" periods and when the Arlington station is broadcasting time signals. On the program will be opera singers, jazz orchestras, instrumental soloists, and all others whose work of art are certain to please those thousands of persons who will be listening in. In addition there will be the usual story for little children, an address by Mr. Crosley in which he will greet his thousands of unseen friends, and addresses probably by Harry L. Davis, governor of Ohio and by Mayor Carrel, of Cincinnati.

And every operating night thereafter there will be programs of great interest, one man devoting all his time to the preparation of them. During the day there also will be elaborate programs, intermingled with government weather reports and the very valuable market quotations supplied by the Fifty-third National Bank, of Cincinnati, and the reports of the New York Stock Exchange, supplied by the Westheimer Company, brokers, also of Cincinnati.

Featured in Radio Shops

The Hatfield Company

A radio set purchased today from a dealer out of business tomorrow means absence of service to the purchaser. It is well, therefore, to regard the past performance of your radio dealer before investing too much of your money in his enthusiasm.

The Hatfield Electric Company of Indianapolis came into existence in the year 1887 under the name of the Indianapolis District Telegraph Company, the owner at that time being Charles C. Hatfield. This company was formed to install night watch signal boxes for the protection of factories and office buildings and the operation of a package and message delivery system.

In the spring of 1888, Mr. Hatfield entered into the electrical contracting business as a side line to the Indianapolis District Telegraph Company. Although very few contracts were had during the first year the reputation established by the Indianapolis District Telegraph Company began to show results and during the four years following 1887 the business rapidly grew into large proportions.

In 1892, Mr. Charles C. Hatfield took into partnership with him, his son, T. Barlow Hatfield, the present head of the Hatfield Electric Company.

The years between 1892 and 1900 showed continued and successful growth to the company. In 1901, the business was expanding by adding electrical appliances and supplies of a varied character and from that time until 1906, the business continued to show really remarkable strides, necessitating a change to larger quarters.

In 1906, the Indianapolis District Telegraph Company sold its assets and good will, in respect to their telegraph, messenger and delivery business, to the American District Telegraph Company and gave all of the attention of the organization to the electrical contracting and dealer business. The name was then changed to Hatfield Electric Company.

From 1905 to 1915, the business was conducted at 36 South Meridian Street. In 1915, the business was again moved, occupying its present location, 102 South Meridian Street.

In that same year occurred the death of Charles C. Hatfield. The Hatfield Electric Company was then incorporated, taking over the partnership formerly conducted by C. C. Hatfield and T. B. Hatfield.

From that date on the business continued to grow into large proportions. At no time in the history of the Hatfield

In the fall of 1921 the company entered into the radio field. In March, 1922, they erected their Broadcasting Station (WOH) one of the most powerful and efficient Broadcasting Stations in the Middle West.

The Hatfield Electric Company began the manufacture and distribution of complete radio receiving sets only after a very thorough investigation. Exhaustive tests were made by experts and not until Mr. Hatfield was personally assured of the practicability of the Hatfield sets would he permit of their general distribution. The policy of the company until recently has more or less restricted that distribution to points adjacent to the state of Indiana. The company did not want Hatfield sets sold promiscuously throughout the country until every phase of radio manufacture and merchandising had been thoroughly tested.

It is, therefore, with confidence that the Hatfield organization today faces radio as an industry. They believe they have designed one of the most efficient receiving sets on the market and they believe their record as a successful corporation in other electrical fields is such as to inspire confidence on the part of their customers.

(Editor's Note: The foregoing was culled from "The Broadcaster," a monthly periodical of the Hatfield Electric Co. of Indianapolis. Mr. Harrison Durant is the editor.)

Broadcasting Opera

The Chicago Radiophone Broadcasting Station of the Westinghouse Electric & Manufacturing Company holds one world's record of which it is very proud. KYW, as it is registered with the government, was the first station in history to broadcast grand opera. This occurred during the celebrated regime of Mary Garden as director of the Chicago Grand Opera Company and was the particular event of the radio world during the time opera was broadcast. KYW was, also, the only broadcasting station ever to broadcast an entire operatic season as it did in Chicago during the season just ended.

Since it was first started KYW has been faithfully operating every night as well as during the day. In addition to broadcasting grand opera, it put into effect a number of innovations in radio, among which were the broadcasting of daily stock reports from the Chicago Board of Trade rooms. Another new thing which Chicago first tried was the installation of a pipe organ in the broadcasting studio in order to send out this beautiful music when selections were played that required an organ for best rendition.

The station at KYW, which is on top of the Commonwealth Edison Building, has recently been made more powerful and has had its antenna raised. With these changes, a far greater range can be expected from this station next winter than it previously had.

Atlanta, Ga., newspapers have aroused a lot of interest in their radio rivalry. The *Constitution* and the *Journal* report messages from distant points telling how their broadcasting has been picked up in St. Louis, and westward, and the *Journal* reports it reached Merida, Yucatan State, in Mexico.

Free Radio Concerts

Following is a list of Chicago radio shops where the public is welcomed to hear radio concerts:

Macauley & Nevers, 155 West Madison Street.

National Radio company, 6 North Wells Street.

Newark Electric company, 230 West Madison Street.

Illinois Electric company, 314 West Madison Strreet.

Electric Service Products company, 12 South Wells Street.

Telephone Maintenance company, 20 South Wells Street.

Manhattan Electric Supply company, 114 South Wells Street.

Triangle Electric company, 160 West Lake Street.

Chicago Radio Dealers, 122 North Dearborn Street.

Dearborn Radio store, 110 North Dearborn Street.

Lyon & Healy, 243 South Wabash Avenue.

Revell & Co., 141 South Wabash Avenue.

The Music Shop, 214 South Wabash Avenue.

Stebbins Hardware company, 15 West Van Buren Street.

Central Electric company, 316 South Wells Street.

Kraut & Dohnal, 325 South Clark Street.

Commonwealth Edison company, 72 West Adams Street.

The Fair, 137 South Dearborn Street.

Chicago Radio Apparatus company, 415 South Dearborn Street.

Steiner Electric company, 115 North Wells Street.

Electric & Radio Supply company, 165 North Wells Street.

Chicago Electric Supply company, 360 West Madison Street.

Leiter Stores, State and Van Buren Streets.

Chicago Salvage Stock store, 509 South State Street.

Ray-Di-Co organization, 1215 Leland Avenue.

Northern Radio Supply corporation, 544 West Washington Street.

Benson company, 2429 South Michigan Avenue.

Kramer Radio company, 4713 Sheridan Road.

Grayland Electric company, 4063 Milwaukee Avenue.

Frankel Bros., Diversey Parkway and Lincoln Avenue.

Marks Electric and Radio shop, Leland and Sheridan Road.

Apex Radio company, inc., 1103 West 69th Street.

General Radio Supply company, 5052 Broadway.

Hillinger Electric shop, 7024 North Clark Street.

United Radio & Electric company, 236 South Halsted Street.

Spreading the Gospel

(From Atlanta (Ga.) *Journal.*)

The Wesley Memorial church, pioneer in the movement to spread the Gospel throughout the land through the aid of radio, reports tremendous interest in this project by churches within the receiving radius of WSB since the Journal installed special apparatus at the church and began broadcasting the evening services.

According to H. K. Chapman, lay leader at Wesley Memorial, requests for prices and information concerning receiving sets for installation in remote districts where the word of God is seldom heard are being received from Methodist Churches wishing to fall in line with the Wesley Memorial's plan.

Another splendid feature inaugurated by the Wesley Memorial Church of Atlanta, is the installation of a radio receiving set with a loud speaker in the main auditorium of the church. An invitation is extended to all by the church to drop in and listen to the programs broadcast during the day from WSB.

The Journal's radio department has received many letters acknowledging the clear reception of the services from the church, broadcast every Sunday evening by WSB and the following is but one among many received by the pastor, Dr. B. F. Fraser.

H. L. Phillips, Seneca, S. C.: "Your sermon tonight (August 6) was enjoyed by several listening on my radio at my home here. You could be heard plainly and distinctly all over the room.

W. M. Brier, Tigerville, S. C.: "Away up in the Blue Ridge mountains of South Carolina you had an audience of some fifteen or twenty people last night (August 6), who sat on the porch of the lodge and listened to you preach to your congregation in Atlanta. We heard the singing of the people and that last song, 'Perfect Day' was fine. We heard you say 'I invite your attention to this text for the evening' and after a pause, 'possibly there is no more familiar passage in the Scripture than the one I have chosen for a text.' Your closing announcements were very clear. If you have never experienced sitting and listening to a minister hundreds of miles away, you cannot fully appreciate the solemnity of the occasion; everybody sits with rapt attention, even leaning forward in their seats in order not to miss a word. To my mind it places the greatest responsibility on the preacher he has ever had. The novelty may wear off but before that time comes there will be many who will listen to the solemn words of the ministers and be drawn closer together by the sweet singing of the people. Not until I sat listening to you last night had I seen God's hand in the working of the miracle radio. I could not go forward last night and shake your hand but I can write a letter and tell you how much I appreciated your words."

Send $1.00 to Radio Age, 64 Randolph Street, Chicago, and receive this middle-west radio periodical for six months.

Magnavox in School

A most interesting installation has recently been completed for the Piedmont High School, Piedmont, California, involving a distinct improvement over present methods of inter-classroom communication.

Developed by The Magnavox Company, pioneers in the field of devices for sound amplification, the installation consists of a central or master station and 25 receiving stations, each equipped with a No. LS-2 Magnavox Telemegaphone, the motor generator and battery being installed in a steel cabinet in the basement.

The master station is operated like an ordinary telephone (as illustrated). Talking into the Magnavox in ordinary tones, the speech is amplified in any or all of the 25 classrooms as desired, in sufficient volume to be distinctly audible to all the students.

While similar Magnavox installations have already been developed for hotel, railroad terminal and similar commercial uses, this is its first application to school service. A distinctly novel feature of this particular installation also is the fact that, by means of a special switch, broadcasted radio lectures and concerts may be connected so as to be reproduced in any or all the classrooms by the same Magnavox Telemegaphones.

One month for drawing the plans and another month for installing the equipment were required by the Magnavox engineers in charge.

This new development of radio reception and amplification suggests most interesting possibilities in other fields.

Philadelphia Show

The American Radio Association which staged the successful Radio Shows in Pittsburgh and Detroit last spring announce that the first Philadelphia show which was postponed from June until this fall will be held in the Industrial Exposition building in the Quaker City, September 27 to 30 inclusive.

Philadelphia, the third largest market in America, did not develop interest in the industry as quickly as some other cities but, with the impetus which has been given during the past summer and spring, the dealers, jobbers and manufacturers are now looking to this rich field as their next campaign grounds. Surrounded by large populous cities, Philadelphia, in addition to its almost two million people, is the trading center for three million more.

A general invitation to dealers within this trading area is being sent out by the managers of the show who plan to make this a mart for buying fall and winter supplies. Special days will be reserved for these visitors and facilities for the transacting of this business will be afforded.

Mr. L. T. Davies will be in direct charge of the affair, and will be assisted by the members of his experienced staff as well as by the Philadelphia dealers and jobbers. The usual educational features which the American Radio Exhibitors' Association afford at their shows will be on the program at this show.

The Radio Homcharger

Beauty has been combined with utility in the new RADIO HOMCHARGER DE LUXE, a battery charging rectifier developed by the Automatic Electrical Devices Company, 146 West Third Street, Cincinnati, Ohio, especially for the HOMCHARGING of Radio A and B batteries.

Finished in a dull mahogany and beautiful old gold, it harmonizes with the finest room furnishings, and permits the radio enthusiast to recharge his battery after an evening's entertainment, without even disconnecting it from his set.

The RADIO HOMCHARGER DE LUXE is constructed upon the same perfect operating principle used in the Type A HOMCHARGER, which has heretofore been the most popular battery charging rectifier in the radio field. Its working parts are entirely enclosed, eliminating all danger of shock and fire. It is constructed of the highest grade materials throughout—moulded Bakelite Base—Jewel Ammeter—Oversized Silicon Steel Transformer. There are no frail castings to break, as all parts are made from highest quality stampings.

It will fully charge any A or B storage battery overnight at a cost of only a few cents. Conforms to the latest Underwriters' requirements and requires no watching.

It is being sold by all the leading radio, electrical and accessory dealers at the uniform price of $18.50. The above company has issued a very handsome booklet, illustrating the Radio HOMCHARGER DE LUXE in actual colors, which is free for the asking.

WIRELESS

New License Quiz Book

FOR

APPLICANT

TO

United States Government
New Rating of
Radio Operator's License Examinations

This is the first edition printed with the new rules, regulations and gradings laid down by the government. It gives a full description of various hook-ups, new devices, practical equations, international law and regulations, official gradings, diagrams, definitions and other important information.

No amateur or wireless professional can afford to be without this book.

107 pp. *80 Illus.* *Price $1.00*

RADIO AGE
64 W. Randolph St. **Chicago**

Fake Radio Stock Promotion

PREDICTION that the radio industry would attract flocks of fake promoters and financial parasites have come true, according to the findings of the Better Business Bureau of New York City. This organization had been in operation for only a few days when it began receiving complaints against alleged wild-cat radio companies that were hawking their securities throughout the city.

The Bureau has just made public a report of the investigation of what it terms one of the most reprehensible of these blue-sky, mushroom companies, organized a few months ago with an authorized capital of $4,000,000, the par value of the stock being $1. The sales organization of the company has been active in hawking stock and has already taken in many thousands of dollars.

According to H. J. Kenner, Manager of the Better Business Bureau, radio get-rich-quick schemers are running true to form. They organize their corporations on a shoe-string and induce the public to finance their ventures and pay for manufacturing or distributing experiments. Having launched their stock sales campaigns, the wild-cats take care of themselves first, by fat salaries for services, which consist principally in selling to the public more stock through wild promises. The cost of promotion is prohibitive, forty to ninety per cent of the money paid for stock going to the sales organization.

"Their cupidity stirred by the popularity of radio, professional promoters —and others—are attempting to broadcast among wage earners and other uninformed investors millions of shares of stock in enterprises alleged to be formed for the purpose of manufacturing and distributing radio apparatus for amateur uses," says the special report of the Better Business Bureau, in discussing the first get-rich-quick radio scheme it has investigated. Right at the beginning of its investigation the Bureau recognized in the leading spirit of this particular outfit a professional promoter whose methods in promoting a motor stock last year called for action by the National Vigilance Committee of the Associated Advertising Clubs of the World.

"In line with the usual practice of venders of blue-sky securities, this radio stock was recently advanced in price from $1 (par value) to $1.50," says the bulletin, which quotes an official of the company as saying that this boost was justified as the company had been making big profits all the time, 300 per cent being the average made on most of the products turned out.

But the trouble with the 300 per cent profit, the Bureau found, was that it existed mostly on paper. The company was producing so little that its profits from merchandise sales were almost negligible. Nevertheless, an executive of the company stated that because of enormous profits, shares would be selling for $4 each, before the snow flies.

But, according to the Better Business Bulletin, the leading promoter of the company admitted, under cross-examination, that his concern would be insolvent if he did not feed it money constantly from stock sales. Another official of the company admitted early this month that his company was insolvent; that it had not operated at a profit and that the unfilled orders, which stock salesmen said were piled up in the offices of the company, amounted to only a few thousand dollars.

During the past few months, the bulletin states, the radio company in question has been flooding the United States mails with stock-selling literature of the wild-cat variety. Thus, the officers members of the board of directors and others connected with the company were described in glowing terms as world leaders in their line who had forged their way to the top in this new industry.

One of the directors is described as the former financial advisor of one of the most famous banking houses of the world, who had been the associate of J. P. Morgan, Cornelius M. Bliss, Jr., Governor Benjamin Strong, Jr., J. D. Rockefeller, Jr., the late Henry P. Davison, Herbert Hoover and others.

The bulletin states that the director in question promptly denied that he had ever achieved these financial honors and then severed his connection with the radio company. It states also that the promoters claimed a vice president of one of the best known and most reliable banking houses of New York City has joined their Board of Directors, but that this also proved false.

"In order to impress prospective stockholders with the flourishing condition of the corporation," the bulletin continues, "Salesmen said that enormous profits were being made, that 40 to 50 men were at work in the factory leased by the company in New Jersey, and that its products had been bought by the De Forest Company and by Butler Brothers, the mail order house.

"Investigation showed these statements to be false. According to an official of the company, not more than 12 people, mechanical and clerical, were employed in the company's so-called plant at Newark, at the time these statements were being made to credulous prospects. Officers of the prominent companies named as customers deny that they have purchased goods of this radio products company."

Another advertising claim stated that the output of four factories had been taken over by this flourishing radio concern, but according to the Better Business Bureau Bulletin, "This representation narrows down to the fact that contracts have been made with two small factories to take their products at prices which a consulting engineer of the radio company has admitted to be 'high'."

"Not the least deceptive of the buncombe employed in the selling of the stock has been the radio-equipped motor car which has been driven about the streets of New Yor,," the bulletin continues. And it points out that the car, which was used to create interest in radio in general and the company's securities in particular, was actually not equipped with apparatus of the corporation's own manufacture.

The Better Business Bureau found further that an invention exploited eloquently by the radio company as one that would revolutionize the industry had not been patented, so claimed by the company, but that applications for patents were merely pending, and that the control of the patent was the subject of a court dispute between the radio company and the inventor. In closing, the Better Business Bureau bulletin states:

"Authoritative information available in the radio industry does not bear out the claim that,

"Manufacturers of every kind of radio telephone accessories, parts and equipment are today taxing hundreds of factories to their limit.

"While the future demand for radio supplies is expected to be considerable, following the summer season dullness, there is no indication that the demand will be abnormal. Dealers and jobbers have, in general, adequate stocks on hand and manufactuters already established have caught up with the demand. On dependable trade authority, it can be said that, today, where is no shortage of radio apparatus for amateur use, and none is anticipated, because factories already in production will be able to fill orders promptly.

"Literally, thousands of new companies have been incorporated, within the present year, to manufacture radio apparatus. No one can predict with any great degree of certainty the extent to which radio enthusiasm on the part of amateurs or its users in commerce will stimulate and sustain demand for apparatus and parts. It is anticipated that progress will take place along broad lines in the distribution of educational and market information, development depending largely on improvements in broadcasting and, to some extent, in receiving, apparatus. It appears that commercial use of radio will be limited, and of a kind which may supplement and extend, rather than compete with, the present public service of telegraph and telephone systems.

"The development of radio at present is in the hands of substantial business men who are interested in its sane progress. These men have their feet on the ground and are neglecting no opportunity to advance this new art and industry. Improvements are being made scientifically by trained technical men specializing in research work. It is possible that unattached inventors and professional promoters, may, by chance, present opportunities of merit to investors, but, in such event, the public should know that these new enterprises are subject to much more than normal business hazards and risks."

Questions and Answers

"Trouble" Department of Radio Age, Conducted by Frank D. Pearne, Technical Editor

L.L., NEWARK, ILL.

Question: I have a vacuum tube detector outfit, but am unable to get any reception. Please send me a hook-up for the outfit. I have an aerial about ninety feet long and about thirty feet high, a rheostat, six-volt battery, a vacuum tube and socket, a grid leak and condenser, an inductance coil, a potentiometer, a plate battery and a pair of 2,000 ohm receivers. Am sending sketch showing the way it was connected when I purchased it, but I am unable to hear anything. Please let me know what to do as I am anxious to get it to working.

Answer: If your set was purchased with the connections which you show in your sketch, it never did work and never will until the circuit is changed. If you will send me a description of the inductance used in the set I will send you a hook-up by return mail, but as you show it, it is impossible to tell just what you are using.

J. W. R., Indianapolis, Ind.

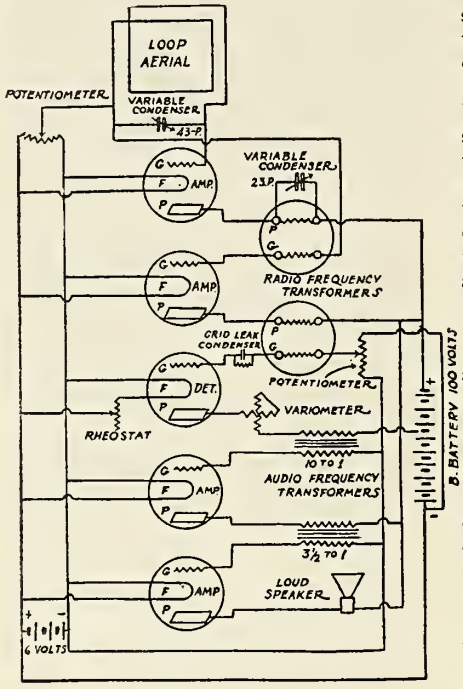
Question: I have constructed the receiving set given on page seven of your June issue of Radio Age. I hear very well using head phones, but would like to hook up a loud speaker. How would you suggest that I arrange the amplifying set so as to just add it to my present set? On page fourteen of the June issue, is an article by Edwin Nielson, showing a set-up using three crystals and two amplifying transformers. Is this a good method? Is the arrangement shown right for a loud speaker, or should the "B" battery be moved up into the second amplifying circuit? I am enclosing a sketch of my circuit.

Answer: I have had no personal experience with Mr. Nielson's circuit, so cannot say as to its value, but he claims to have tried it with great success. Your present set should work very well in connection with it, but I would not change the position of the battery if I were you. Also, the phones which you show in the circuit, should be disconnected when the primary of the transformer is connected as shown. It would be advisable to use a switch in the "B" battery circuit, so that the current can be cut off when not in use. Any ordinary audio-frequency transformer should do this work, but it should have a ten to one ratio.

F. G. M., Marengo, Ill.

Question: Do you think that my set, shown on the enclosed paper, could be improved by adding two or three steps of radio frequency? Will radio frequency amplification give louder results than audio frequency? Will I have to change my aerial, that is, must it be larger for radio frequency, or will the one described work all right? Can you give me a good circuit which I can use for this purpose?

Answer: Yes, I think the radio frequency would help a great deal. Do not



get the impression, however, that this is going to increase the volume of sound to any marked degree. Radio frequency, if connected in the circuit ahead of the detector, will bring in signals from stations much farther away than those which are received without it, but they do not produce much amplification. As a general thing two or three steps of radio frequency are used first to bring in the distance, then the detector cuts it down to audio frequency and it is then amplified in volume by two steps of audio frequency amplification. All the aerial you will require for such a set will be a loop four feet in diameter, with six turns of wire on it, about a half an inch apart. This is used in the room with the set. The accompanying hook-up will explain how it is done.

L. M. McD., Jr., Michigan City, Ind.

Question: I am enclosing a drawing of my circuit which I believe is the same as that used in the Paragon. I had no trouble with it until about a week ago when it seemed to work all right for a little while and then the music began to get weaker. Any adjustment I used would not make it any louder and it continues to act the same way now. The connections are all right and my batteries are in good condition, but what gets me is that it will work for a little while every time I listen in, and in a few minutes it is gone. Can you tell me what is the matter?

Answer: Yes. Your filament battery is weak. You do not say what kind of a battery you are using, but I suppose it is a storage battery. Don't let your eyesight fool you. The filaments may seem to burn brightly, but still there is not quite power enough to give results. When you first start to listen in, your battery has had a rest, and has recovered slightly, but after a few minutes' use the pressure begins to drop, although the filaments apparently are as bright as they should be. Give your battery a charge if it is of the storage type and if you are using dry cells, throw them away and get new ones.

B. H. R., Anamosa, Iowa.

Question: My antenna is 100 feet long and about 40 feet high, using two No. 14 wires. Is this good enough to get the broadcasting stations from Chicago? What is the wave length of it and what would be its wave length if I used four wires instead of two? Should it run east and west, or north and south? If this antenna is not good will you please tell me how to improve it?

Answer: Your aerial is very good and you should not have any trouble in getting stations much farther away than Chicago if you have a set which is sensitive enough to pick them up. It is not possible to accurately calculate the wave length of an aerial having more than one wire and the only way to get this correctly is to make a test with a wave meter. In regard to the direction in which it should run, this is a matter for you to judge. If you are close to heavy power lines you will have no choice, but will have to run at right angles to these lines. If you are free from any troubles of this kind, then you should point your aerial towards the station from which you desire to get signals.

M. V., Chicago, Ill.

Question: I am getting interested in radio and want to get a good set. What make of instrument would you recommend which will give good service for a distance of 500 miles? Could I buy the parts and make it myself? I am very ignorant when it comes to anything electrical, but am quite handy with tools.

Answer: I regret that it is against the policy of this publication to recommend any particular make of instrument, but if you will look through the advertisements in this issue, you may rest assured that any of the sets advertised are good, as this magazine will not publish advertising matter from any concern which is not right with their customers. I would not advise you to build the set yourself unless you have had some experience in this kind of work.

P. A. B., Minneapolis, Minn.

Question: Can you advise me so that I can tell the members of our radio club how to construct a three-stage radio frequency, detector, and two stages of audio frequency set, using duolateral or

Questions and Answers

"Trouble" Department of Radio Age, Conducted by Frank D. Pearne, Technical Editor

honey-comb coils and loop antenna for long distance receiving?

Answer: This circuit would require a great deal of space in this column so I I am going to suggest that you add the three stages of radio frequency just ahead of the detector, if you now have the described set. If you have not already constructed such a set, I strongly advise you to give it up and use the circuit shown in this column and addressed to "F. G. M., Marengo, Ill.," as this does not require nearly as much apparatus and my experience has been that this set using the radio frequency amplification is far superior to the honey-comb circuit which you mention. Better yet, if you want to get wonderful results at a very small expense, I would suggest the two tube Armstrong super-regenerative circuit explained in this issue. I refer to the one used by Mr. Paul B. Coats on his automobile.

F. Z., Milwaukee, Wis.

Question: I am a subscriber to your magazine and live in Milwaukee, Wis. I would like to know if I could make a set for about $30, and if I can, please let me know? Please send me the whole plan and let me know what the cost will be.

Answer: I doubt very much if you can make a set that will hear the eastern stations, for the reason that the three bulbs necessary will cost about $18, and the batteries will cost at least $13, which will alone cover your estimated expense, without any of the other materials. I believe the cheapest and most powerful set for this purpose is the Armstrong super-regenerative set shown installed on an automobile in this issue. This set uses only two tubes and is more powerful than any three-tube set which I have seen. It should cost complete about $40.

M. H., Ft. Branch, Ind.

Question: Will you please send me a hook-up using two variometers, one variocoupler, and two stages of radio and two stages of audio frequency amplification? How far should I hear with this outfit? Could I use a loop aerial and get good results? How far could I hear with a loop? Myself and two other fellows are thinking of installing a broadcasting station here. Would you advise it? If there are any charges for this hook-up and questions, please enclose your bill and I will forward a check for same.

Answer: I am sending this hook-up by mail. You should be able to hear 1,500 miles or more with this. If you will use the circuit shown in this column in answer to the question by F. G. M. you can hear just as much and it is less expensive. You can use a loop aerial and get better results than with the other type. In my opinion radio frequency sets operate better with a loop. You can hear just as far, or farther with the loop, but you must turn the end of the loop towards the station you desire to hear, as no results will be obtained if the flat side faces the transmitting station. Broadcasting stations are expensive toys, if you want to reach out very far. You must take a Government examination and get a license before you can use it. There is no charge for information given in these columns, as this is part of the service furnished by the Radio Age to its subscribers.

Shorthand and Radio

Miss Ruth Baker, of Pittsburgh, who increases her speed in shorthand by taking down speeches and programs from her radio receiving set.

A novel aid in the study of shorthand, the taking of dictation from wireless speeches and programs, is the latest means of utilizing radio receiving sets in Pittsburgh.

Ruth Baker, who lives at 118 East Ohio Street, Pittsburgh, Pa., listens in and transcribes the text of speeches into shorthand notes, while enjoying the radio program, broadcasted from KDKA, the Westinghouse Electric & Manufacturing Company's radio broadcasting station at East Pittsburgh, Pa., and thus finds unlimited opportunity for practice.

"It's really fun," Ruth declares. "I like to hear the wireless program and I just take down shorthand notes while I am listening to the speakers. Then, instead of having to study my shorthand after the entertainment, all I have to do is to transcribe my notes for practice. It makes study a pleasure."

The method is recommended as an excellent one by Prof. O. B. Hughes, head of Park Institute, Pittsburgh, where Ruth attends. Many other schools are advising their pupils to employ the radio in similar fashion.

Cincinnati Exposition

Arrangements have just been completed for the Cincinnati Electrical and Radio Exposition which will take place October 2 to October 7, inclusive, at Music Hall.

The exposition will embrace exhibits, contests and entertainments more diversified and extensive than ever previously undertaken in this city.

Everything electrical will be shown, including devices for communication, notification and safety warnings, but particularly specializing in appliances for household use and radio equipment.

The exhibits will occupy the south wing of Music Hall, while the auditorium will be used every afternoon and evening for radio concerts, lectures on radio topics by authorities of national reputation who will be brought here by the exposition management for the purpose.

In addition to the radio entertainments and discussions there will also be given demonstrations and informative talks upon the use of electrical household labor-saving applicances by domestic experts.

The radio section of the exposition will embrace exhibits of the many improvements and developments perfected in recent months and taking place at a season of the year just after radio communication has suffered somewhat by the impediment of "summer static," the inventions and discoveries that have minimized that handicap will receive particular attention and attract special interest.

The management has arranged to attract and encourage the radio amateurs of this section by offering valuable prizes for the best home-made radio receiving sets made by pupils of the graded and high schools of the city and vicinity.

A noteworthy series of demonstrations will be given in both radio sending and receiving. The management has arranged to broadcast concerts from one of the annexes, receiving and amplifying them in the auditorium so that auditors and spectators may visit both the sending and the receiving stations and visualize and hear radio communication from both ends.

Except for entertainment purposes, however, the radio exhibits will form but one section of the exposition, and the exhibits and demonstrations of the usefulness of electrical devices and household appliances will be given equal prominence.

McElroy Is Champion

The Radio Marathon, held Sunday morning, August 6, at 10 a. m., in Congress Hall of the Pageant of Progress Exposition on the Chicago Municipal Pier, was a highly interesting and unusual event, and the first of its kind ever held in the Middle West.

The Radio Marathon was a speed contest for radio operators in receiving straight commercial press in the Continental Code, and simultaneously transcribing the message on regulation Western Union typewriters.

Contestants included T. R. McElroy of the Western Union Telegraph Company, from Boston, holder of the present world's record of 56½ words per minute; B. G. Seutter, of the New York Times Radio Department, from New York; Benedict D. Brankey, of the Western Union Telegraph Company, from Chicago; and M. Swartz, assistant radio inspector, 9th district.

The test was conducted by Lawrence R. Schmitt, formerly United States Radio Inspector, 9th District. The judges were Captain Alfred Thomas of the Radio Corporation of America, E. A. Beane, U. S. Radio Inspector, 9th District, and Mr. Schmitt.

At 10:00 a. m., the contestants were seated at the test table on the stage of Congress Hall, wearing the telephone head sets and at attention with their typewriters, ready for the signal to start. The automatic sending machine clicked off the dots and dashes from a tape delivered under seal for this contest. The starting speed was 40 words a minute. Succeeding tests were run for two-minute intervals, increasing the speed 2 words per minute at each test.

Brankey was eliminated at 46 words a minute, Swartz at 48. The contest was now on between Seutter and McElroy. Seutter was eliminated at 52 words a minute. McElroy was presented with the diamond medal by Geo. E. Carlson, Commissioner of Gas and Electricity of the City of Chicago, when he copied 52 1/5 words per minute, perfect copy.

McElroy attempted to beat his world's record of 56½ words a minute with three errors. He succeeded in copying 55 1-10 words per minute perfect copy, and in another test copied 58 words per minute with five errors. This is considered by all operators to be little short of marvelous. In commercial work, manual speed is usually limited to not more than 45 words per minute. A machine is used for copying greater speeds and the message as copied on a tape is repeated at a slower speed to permit its transcription. McElroy's skill places him in a class as a human machine. To add interest for the spectators, the dots and dashes were sent through a loud speaker. Many of the audience expressed surprise that any one could be able to decipher the code. McElroy's record message at the rate of 55 1/10 words per minute was as follows:

"STATES ARMY CORPS WILL BE RECEIVED BY THINKING FOLK EVERYWHERE. AMERICAN LEGION OFFICIALS RECENTLY STARTED ON GENERAL SAWYER'S TRAIL. THEY ACCUSED HIM OF HASTENING AND HOLDING UP THE PROGRAM OF FEDERAL HOSPITALIZATION. GENERAL SAWYER IS CHIEF COORDINATOR OF THE HOSPITALIZATION BOARD. THEY HAD BETTER INVOKE PUBLIC SENTIMENT BACK OF GENERAL SAWYER INSTEAD OF HOBBLING HIM, ASSERTED MR. DAWES. THEN HE SAID THERE WAS ALTOGETHER TOO MUCH RUNNING TO COVER BY GOVERNMENT OFFICIALS EVERY TIME THE AMERICAN LEGION GROWLED AT THEM, FEARING THAT THE SEEDLESS PUBLIC WOULD ALL TOO QUICKLY ASSUME THAT THE LEGION WAS RIGHT WHATEVER THE FACTS MIGHT BE. MR. DAWES ASSERTION OF HIS."

The time was started with the word, "will." Five letters were taken as the average word. The word "seedless" was checked by the judges and found to be correct with the punchings on the sending tape.

After Mr. McElroy had won the contest by copying 52 1/5 words per minute

NEW STATIONS

List of stations broadcasting market or weather reports (485 meters) and music, concerts, lectures, etc. (360 meters), alphabetically by call letters.

Call signal.	Station operated and controlled by—	Location of station.	Wave lengths.
KDZW	Claude W. Gerdes	San Francisco, Calif., 2198 O'Farrel St.	360
KDZX	Glad Tidings Tabernacle	San Francisco, Calif., 1536 Ellis St.	360
KDZZ	Kinney Bros. & Sipprell	Everett, Wash., 1705 Hewitt Ave.	360
KFAB	Pacific Radiofone Co.	Portland, Ore., 108 N. Broadway	360
KFAC	Glendale Daily Press	Glendale, Calif., 222 S. Brand Boulevard	360
KFAD	McArthur Bros. Mercantile Co.	Phoenix, Ariz., 134 S. Central St.	360
KFAE	State College of Washington	Pullman, Wash.	360
KFAF	Western Radio Corp.	Denver, Colo., 737 Lincoln St.	360
KFAJ	University of Colorado	Boulder, Colo.	360
WEAN	Shepard Co.	Providence, R. I.	360
WEAO	Ohio State University	Columbus, Ohio	360, 485
WEAP	Mobile Radio Co.	Mobile, Ala., O'Gwinn Building	360
WEAQ	Young Men's Christian Association	Berlin, N. H.	360
WEAR	Baltimore American & News Publishing Co.	Baltimore, Md., Munsey Building	360
WEAS	Hecht Co.	Washington, D. C., Seventh and F Sts. NW	360
WEAT	John J. Fogarty	Tampa, Fla., 707 Azeele St.	360
WEAU	Davidson Bros. Co.	Sioux City, Iowa	360
WEAV	Sheridan Electric Service Co.	Rushville, Nebr.	360
WEAX	T. J. M. Daly	Little Rock, Ark., P. O. Box 614	360, 485
WEAY	Will Horwitz, jr.	Houston, Tex., 612 Travis St.	360
WEAZ	Donald Redmond	Waterloo, Iowa, 1120 Bertch Ave.	360
WEH	Midland Refining Co.	Tulsa, Okla. (300 S. Main St., Eldorado, Kans.).	360, 485
WFAA	A. H. Belo & Co.	Dallas, Tex.	360, 485
WFAB	Carl F. Woese	Syracuse, N. Y., 802 McBride St.	360
WFAC	Superior Radio Co.	Superior, Wis., 2326 John Ave.	360
WFAD	Watson Weldon Motor Suppy Co.	Salina, Kans., 217 N. Santa Fe St.	360
WFAF	H. C. Spratley Co.	Poughkeepsie, N. Y., 357 Main St.	360
WFAG	Radio Engineering Laboratory	Waterford, N. Y., Sixth and Broad Sts.	360
WFAH	Electric Supply Co.	Port Arthur, Tex., 637 Proctor St.	360
WFAJ	Hi-Grade Wireless Instrument Co.	Asheville, N. C., 47 Zillicoa St.	360
WFAK	Domestic Electric Co.	Brentwood, Mo., 908 Pine St.	360
WFAL	Houston Chronicle Publishing Co.	Houston, Tex.	360, 485
WFAM	Times Publishing Co.	St. Cloud, Minn.	360
WFAN	Hutchinson Electric Service Co.	Hutchinson, Minn.	360, 485
WFAP	Brown's Business College	Peoria, Ill.	360
WFAQ	Missouri Wesleyan College and Cameron Radio Co.	Cameron, Mo.	360
WFAR	Hall & Stubbs	Sanford, Me., 1 Bennett St.	360
WFAS	United Radio Corp.	Fort Wayne, Ind., 107 E. Main St.	360
WFAT	Daily Argus-Leader	Sioux Falls, S. Dak., 109 N. Main Ave.	360
WFAU	Edwin C. Lewis	Boston, Mass., 121 Federal St.	360
WFAV	University of Nebraska, department of electrical engineering.	Lincoln, Nebr.	360, 485
WFAW	Miami Daily Metropolis	Miami, Fla.	360
WFAX	Arthur L. Kent	Binghamton, N. Y., 199 Court St.	360
WFAY	Daniels Radio Supply Co.	Independence, Kans.	360
WFAZ	South Carolina Radio Shop	Charleston, S. C.	360
WGAB	Q R V Radio Co.	Houston, Tex., 1213 Prairie Ave.	360
WGAC	Orpheum Radio Stores Co.	Brooklyn, N. Y., 637 Fulton St.	360
WGAD	SpanishAmerican School of Radio telegraphy	Ensenada, P. R.	360
WGAF	Goller Radio Service	Tulsa, Okla., 20 E. Eleventh St.	360
WGAH	New Haven Electric Co.	New Haven, Conn., 296 Elm St.	360
WGAJ	W. H. Gass	Shenandoah, Iowa, 413 Seventh Ave.	360
WGAK	Macon Electric Co.	Macon, Ga.	360
WGAL	Lancaster Electric Supply & Construction Co	Lancaster, Pa., 23 E. Orange St.	360
WGAM	Orangeburg Radio Equipment Co.	Orangeburg, S. C.	360
WGAN	Cecil E. Lloyd	Pensacola, Fla., 216 W. Romana St.	360
WGAQ	W. G. Patterson (Glenwood Radio Corp.)	Shreveport, La.	360
WGAR	Southwest American	Fort Smith, Ark., 507 Rogers Ave.	360
WGAS	Ray-Di-Co Organization	Chicago, Ill., 1547 N. Wells St.	360
WGAT	American Legion, Department of Nebraska	Lincoln, Nebr., 314 Richards Block	360
WGAU	Marcus G. Limb	Wooster, Ohio, 235 E. Liberty St.	360
WGAV	B-H Radio Co.	Savannah, Ga., 204 W. Broughton St.	360
WGAW	Ernest C. Albright	Altoona, Pa., 1918 W. Chestnut St.	360
WGAY	North Western Radio Co.	Madison, Wis., 250 State St.	360
WGAZ	South Bend Tribune	South Bend, Ind.	360
WHAA	State University of Iowa	Iowa City, Iowa	360
WHAB	Clark W. Thompson (Fellman's Dry Goods Co.).	Galveston, Tex.	360, 485
WHAC	Cole Bros. Electric Co.	Waterloo, Iowa	360
WHAD	Marquette University	Milwaukee, Wis.	360
WHAE	Automotive Electric Service Co.	Sioux City, Iowa	360
WHAF	Radio Electric Co.	Pittsburgh, Pa.	360

perfect copy, Commissioner Carlson offered a prize of $50.00 additional in case the World's record was beaten. As stated above, Mr. McElroy established a World's record of 55 1/10 words per minute perfect copy. Before awarding the prize, and to remove all doubt as to whether or not 55 1/10 words perfect copy was superior to 56½ words per minute with four errors, which was the previous record, Commissioner Carlson obtained an opinion from a commission of five experts relative to this record. The commission consisted of Mr. E. J. Nally, President of the Radio Corporation of America, Mr. E. R. Shute, Operating Engineer of the Western Union Telegraph Company, Captain Alfred Thomas, District Manager of the Radio Corporation of America, Mr. E. A. Beane, U. S. Radio Inspector, 9th District, and Mr. L. R. Schmitt. The entire commission are uniformly agreed that perfect copy is the standard for consideration, and are, therefore agreed that 55 1/10 words per minute perfect copy is a new world's record.

Chicago's Winter Show

January has been selected as the month when the second annual National Radio Exposition will be held in Chicago. This was chosen for several reasons. By that time the radio industrial atmosphere will have sufficiently cleared to enable the manufacturer, jobber and dealer to know where he stands, the annual inventories will have been taken, and an adjustment will have been reached in this rapidly growing industry which will have stabilized it to a large degree.

There was another factor in causing the Advisory Commitee of the second National Radio Exposition to select this particular time for the second National show. Consultation with exhibitors in the First National Exposition, held in the Leiter building, Chicago, June 26 to July 1, revealed the fact that the big men in the industry were convinced that with the opening of the new year will come many changes in the radio situation. Long distance reception will have been so much improved as to enable Chicago to hear music and world news direct from England, Scotland and Panama, as well as the most distant points in the United States.

The First Regiment Armory, 16th Street and Michigan Avenue, has been selected as the place for holding the second annual National Radio Exposition, and the dates are to be January 13 to 20, inclusive, according to Milo E. Westbrooke, who is the pioneer in staging radio exposition truly national in character.

One of the features of the second National exposition, as it was in the first, will be the participation of the schools. The high school boy is not only looked upon as the radio manufacturer of the future, but he is the surest vehicle to carry radio into the home.

The school exhibit at the second National Radio Exposition will be on a more extensive scale than at the first show.

GET YOUR MARKET REPORTS FROM ONE OF THESE STATIONS

THE following is a broadcasting schedule of market reports by radio. These reports are sent as press items, except where it is indicated that they are sent in code form. Forms are necessary for copying the reports sent by code, sample copies of which may be obtained from this bureau for Federal and air mail stations and for all others by writing to the broadcasting station direct. While this schedule is not complete, it is the most accurate that can be prepared from the information available and will be revised as rapidly as data are received. With the exception of Federal stations, practically all market, crop, and weather reports are sent out on 485 meters, while entertainment, news, etc., are broadcast on 360 meters.

Federal, State and private market reports.

[Submitted by Bureau of Agricultural Economics.]

Name and call letters of station.	Nature of reports.	Source.	Time of transmission.	Type of transmission
			Eastern standard time.	
Arlington, Va. (Washington, D. C.), Navy Radio Station, NAA.	Live stock receipts five or more principal markets (code).	Federal	8.45 a. m	Telegraph595 meters continuous wave transmission
	Weather forecast	do	10.00 a. m	Do.
	Hog market flash, Chicago and St. Louis	do	11.15 a. m	Do.
	Fruit and vegetable shipments and shipping point information.	do	11.20 a. m	Do.
	Fruit and vegetable markets	do	1.40 p. m.[1]	Do.
	Crop reports and special market news	do	2.25 p. m.[1]	Do.
	Closing live stock markets	do	3.45 p. m.[1]	Do.
	Hay and feed markets, Monday, Wednesday, and Friday.	do	4.00 p. m.[1]	Do.
	Weather forecast	do	5.00 p. m.[1]	Do.
	Daily marketgram	do	5.30 p. m.[1]	Do.
	Weather forecast	do	9.45 p. m	Do.
Ames, Iowa: Iowa State College, WOI.	Information not available		Central time	Phone.
Atlanta, Ga.: Atlanta Constitution, WGM.	Information not available		do	Do.
			Central time.	
Atlanta, Ga.: Atlanta Journal, WSB.	Weather reports	Federal	12.00 noon	Phone.
	Market report, close on cotton, grain, and spot quotations.		2.30 p. m	Do.
	Entertainment	Local	4.00 p. m	Do.
	Ball score, news, etc	do	5.00 p. m	Do.
	Entertainment	do	7.00 p. m	Do.
Austin, Tex.: University of Texas, WCM.	Opening cotton and grain markets		9.30 a. m	Phone.
	Noon call on cotton	Local	12.30 p. m	Do.
	Live stock report	do	2.45 p. m	Do.
	Close on cotton and grain	do	3.15 p. m	Do.
	Laredo onion report and general shipping point news.	do	4.00 p. m	Do.
	Report on markets of Dallas, Fort Worth, Houston, and San Antonio, and general crop information.	do	8.00 p. m	Do.
			Eastern time.	
Boston, Mass. (Worcester): Clark University, WCN.	Weather reports	Federal	11.15 a. m	Do.
	Massachusetts State market reports	State		Do.
	Weather reports	Federal	5.15 p. m	Do.
Bridgeport, Pa.: Diamond State FiberCo., WBAG.	Market and crop reports	do	11.45 a. m	Do.
	(Music Thursday)	Local	7.30 p. m	Do.
Buffalo, N.Y.: Federal Telegraph & Telephone Co., WGR.	New York State market reports	State	12.00 noon	Do.
	Weather reports	Federal	5.30 p. m	Do.
	New York State market reports	State	5.30 p. m	Do.
	Education talks and entertainment	Local	7.30 p. m	Do.
Charlotte, N. C.: Southern Radio Corporation, WBT.	Weath r reports	Federal	11.00 a. m	Do.
	Ball scores, etc	Local	6.00 p. m	Do.
	Market reports	Federal	8.00 p. m	Do.
	Entertainment	Local	8.30 p. m	Do.
			Central time.	
Chicago, Ill.: Westinghouse Electric & Manufacturing Co., KYW.	Fruit, vegetable, live stock, and grain (code)	Federal	2.15 p. m	Do.
	Fruit, vegetable, live stock, grain and dairy products (code).	do	4.15 p. m	Do.
	Fruit, vegetable, live stock, and feeds	do	6.00 p. m	Do.
	Fruit, vegetable, live stock, grain, and dairy products (code).	do	7.30 p. m	Do.
Cincinnati, Ohio:				
Cino Radio Manufacturing Co., WIZ.	Wholesale fruit and vegetable report	do	12.00 noon	Do.
	Live stock reports, Chicago and St. Louis	do	3.00 p. m	Do.
			Eastern time.	
Crosley Manufacturing Co., WLW.	Financial and market report	do	1.00 p. m	Do.
	Entertainment, etc	Local	3.00 p. m	Do.
	Talks, news items, music	do	3.00 p. m	Do.
			Central time.	
Precision Equipment, WMH.	Wholesale fruit and vegetable report	Federal	11.00 a. m	Do.
	Live stock report, Chicago and St. Louis	do	4.00 p. m	Do.
[1]Not broadcasted on Saturdays from June 15 to Sept. 15.				
			Central time.	
Dayton, Ohio: Rike-Kumler Co., WFO.	Weather report	Federal	11.30 a. m	Phone.
	Entertainment and news	Local	9.00 a. m	Do.
	do	do	11.00 a. m	Do.
	Market report and weather	Federal		Do.
	News and entertainment, Monday, Wednesday, Thursday.	Local	4.00 p. m	Do.
	do	do	7.00 p. m	Do.

(*Continued on next page.*)

Lightning Arresters

Many of our readers are still worrying about the lightning scare pertaining to outside aerials. Nearly every day I receive requests for information on this subject and to those interested I wish to say that recent investigation shows that there is actually less danger from this source with an aerial than without; but when the reader reads something like the following, it is no wonder that he becomes anxious.

"Watch out for lightning—beware of fire—injury—or death, as a result of using your radio set with a roof aerial. Thunder-storms with attendant lightning may kill you while you sleep. Protect your family, and your friends. Safeguard your life with a Hoosis lightning protector."

Wow—w—but that does get one scared, but is it a warning from the fire department, or does the municipal or federal government issue such warnings? No, not at all; this is merely an advertisement in the newspapers attempting to sell lightning arresters by the "scare-'em-stiff" method. I do not wish to discourage the use of lightning arresters, because occasionally they do protect delicate radio receiving instruments, and because in some localities they are required by law, but I do wish to discourage hysterical fears, unfounded in most cases, and greatly exaggerated in others. The reason why you need not worry about lightning will be explained in this column tomorrow.—[F. D. P. in Chicago Herald and Examiner.

Wireless Patent Suit

New York.—Action to restrain the Wireless Specialty Apparatus Company from continuing to publish a series of "patent warning" advertisements has been brought in the Supreme Court of New York.

"The suit is being watched with considerable interest by wireless interests, including hundreds of radio apparatus manufacturers and radio dealers throughout the country, who will be guided by court decision as to their rights in regard to the alleged patent infringements contained in the "warning" advertisements.

"The suit is being prosecuted by the Freed Eisemann Radio Corporation, 255 4th Avenue, supported by a group of radio apparatus manufacturers known as the "Independent Radio Manufacturers, Inc."

Operators Suspended

First-class, second-grade license, No. 1359, issued at Baltimore, Md., August 29, 1921, has been suspended for a period of three months for violation of section 5, act of August 13, 1912, in that he willfully interfered with the transmission of another station.

First-class, second-grade license, No. 3895, issued at New York, N. Y., June 27, 1922, has been suspended for a period of three months for violation of article 6 of the International Convention service regulations, in that he carried on an unofficial conversation with the operator of another vessel.

Federal, State, and private market reports—(Continued.)

Name and call letters of station.	Nature of reports.	Source.	Time of transmission.	Type of transmission.
Detroit, Mich.: The Detroit News, WWJ.	Entertainment, etc.	do	9.30 a. m.	Do.
	Weather report	Federal	10.15 a. m.	Do.
	United States time signals	do	11.55 a. m.	Do.
	Entertainment	Local	12.05 p. m.	Do.
	Market quotations	do	3.30 p. m.	Do.
	Weather report	Federal	4.05 p. m.	Do.
	Sport and world news	Local	5.00 p. m.	Do.
	Entertainment	do	7.00 p. m.	Do.
Eldorado, Kans.: Midland Refining. Co., WAH.	Weather and market report	Federal	10.30 a. m.	Do.
	Market report	do	1.30 p. m.	Do.
	Weather report	do	3.30 p. m.	Do.
	Entertainment	Local		Do.
	Market report (Saturday)	Federal	1.00 p. m.	Do.
			Pacific time.	
Elko, Nev.: Air mail radio station, KDEJ.	Live-stock receipts (code)	do	8.30 a. m.	3000 arc undamped.
	Live stock Chicago (code)	do	12.00 noon	Do.
	do	do	4.00 p. m.	Do.
			Central time.	
Fort Worth, Tex.: Fort Worth Record, WPA.	Weather report	do	11.30 a. m.	Phone.
	do	do	2.30 p. m.	Do.
	Market report	do	4.00 p. m.	Do.
	Ball scores and news	Local	6.00 p. m.	Do.
	Entertainment	do	7.30 p. m.	Do.
	News and weather reports	do	10.00 p. m.	Do.
The Star-Telegram, WBAP.	Produce, grain, and cotton opening	Federal	8.45 a. m.	Do.
	Weather report (code)	do	11.00 a. m.	Do.
	Cotton, grain, sugar, and cattle report (code).	Local	2.00 p. m.	Do.
	Fort Worth cash grain	do	3.30 p. m.	Do.
Great Lakes, Ill. (Chicago, Ill.): Navy radio station, NAJ.	Live-stock receipts (code)	Federal	8.00 a. m.	Telegraph4900 meters continuous-wave transmission
	Hog market flash, Chicago	do	8.50 a. m.	Do.
	Weather forecast	do	9.00 a. m.	Do.
	Hog flash five or more markets	do	10.00 a. m.	Do.
	Fruit and vegetable shipments, and shipping point information.	do	10.10 a. m.	Do.
	Dairy products market report, New York and Chicago.	do	10.40 a. m.	Do.
	Live-stock market:			
	Chicago	do	11.45 a. m.	Do.
	Kansas City	do	11.25 a. m.	Do.
	St. Louis	do	11.40 a. m.	Do.
	St. Paul	do	12.00 noon[1]	Do.
	Omaha	do	12.20 p. m.[1]	Do.
	Chicago close code, advance estimated	do	12.40 p. m.[1]	Do.
	Reports:			
	Grain report (code)	do	1.45 p. m.[1]	Do.
	Fruit and vegetable market report	do	2.30 p. m.[1]	Do.
	Hay and feed market report	do	3.45 p. m.[1]	Do.
	Dairy and poultry market report	do	5.00 p. m.[1]	Do.
	Daily marketgram	do	6.00 p. m.[1]	Do.
	Weather forecast	do	9.30 p. m.	Do.
Hutchinson, Minn.: Hutchinson Electric Service Co., WFAN.	Weather and market reports as transmitted by University of Minnesota.	State	1.00 p. m.	Phone
Jefferson City, Mo. Missouri State marketing bureau, WOS.	Market reports, estimated receipts Kansas City, St. Louis, and Chicago hog opening, and Kansas City grain (code).	Federal and State.	9.30 a. m.	Do.
	Kansas City and St. Louis live stock and Kansas City grain.	do	11.30 a. m.	Do.
	Chicago butter and eggs, St. Louis potatoes, and Kansas City grain (code).	do	2.00 p. m.	Do.
	Marketgram, general market information (daily except Tuesdays and holidays).	do	5.00 p. m.[1]	Do.
			Central time.	
Kansas City, Mo.: Sweeney Radio Electric Co., WHB.	Grain market reports for the Kansas City Board of Trade (half-hour schedule).	Local	9.30 a. m. to 12.30 p. m.	Phone.
Western Radio Co., WOQ.	Hog report	Federal	9.45 a. m.	Do.
	Live Stock Kansas City (code)	do	11.30 a. m.	Do.
	Fruit and vegetable	do	11.40 a. m.	Do.
	Grain report (code)	do	2.00 p. m.	Do.
	Live stock Kansas City (code)	do	2.10 p. m.	Do.
	Live stock Chicago (code)	do	2.20 p. m.	Do.
	Fruit and vegetable, Kansas City, Chicago, and St. Louis.	do	2.30 p. m.	Do.
	Repeat the 2 and 2.30 p. m. reports		7.30 p. m.	Do.
Lincoln, Nebr.: University of Nebraska, WFAV.	Omaha hogs and sheep, and grain report for Chicago, Omaha, and Kansas City.	Federal	10.10 a. m.	Do.
	Weather forecast, Nebraska	do		
			Pacific time.	
Los Angeles, Calif.: Leo J. Meyberg Co., KYJ.	Weather forecast	do	9.00 a. m.	Do.
	Lectures University of Southern California	Local	2.30 p. m.	Do.
	Stock exchange report	do	4.00 p. m.	Do.
	Music and entertainment	do	4.00 p. m.	Do.
			Central time.	
Madison, Wis.: University of Wisconsin, WHA	Chicago, potatoes, hogs, cattle, sheep, eggs, butter, cheese, poultry, and hay (code).	Federal	12.00 noon	Telegraph.
	Weather for Wisconsin	do	12.20 p. m.	Do.
	Weather same as at 12.20 p. m.	do	12.25 p. m.	Phone.
	United States time signal	do	12.59 p. m.	Do.
Manhattan, Kans.: Kansas State Agricultural College, WTG.	Weather forecast	do	9.55 a. m.	Do.
Memphis, Tenn.: Reichman-Crosby Co., WKN.	Weather and opening cotton market	do	11.45 a. m.	Do.
	Close on cotton, live stock, and produce	do	2.30 p. m.	Do.
	Baseball news	Local	6.00 p. m.	Do.
	Entertainment	do	8.15 p. m.	Do.
	Sermons (Sunday)	do	11.00 a. m.	Do.

[1]Not broadcasted on Saturdays from June 15 to Sept. 15.

(*Continued on next page.*

Federal, State, and private market reports—Continued.

Name and call letters of station.	Nature of reports.	Source.	Time of transmission.	Type of transmission.
			Daylight saving, central time.	
Milwaukee, Wis.: Gimbel Brothers Department Store, WAAK.	Market quotations of Milwaukee Chamber of Commerce.	....do....	10.00, 11.00, 12.10 and 1.25.	Do.
	Weather forecast (Wisconsin)	Federal	11.00 a. m.	Do.
			Central time.	
Minneapolis, Minn: University of Minnesota, WLB	Weather report, Minnesota, Wisconsin, North Dakota, South Dakota, and Montana.	Local	12.00 noon	Telegraph and followed by phone.
	St. Paul live stock summary of morning's market.	State and Federal.	12.00 noon	Do.
	Minneapolis wheat closing cash and futures, Minneapolis and St. Paul potatoes, summary.	Local and Federal.	7.30 p. m.	Do.
			Eastern time.	
Newark, N. J.: Westinghouse Electric & Manufacturing Co., WJZ.	Market reports, New York City wholesale fruit and vegetable.	State	12.00 noon	Do.
	New York City wholesale fruit and vegetables, eggs, hay, butter, etc.	....do....	6.00 p. m.	Do.
			Central time.	
North Platte, Nebr.: Air mail radio station, KDHM.	Live stock receipts (code)	Federal	9.30 a. m.	Telegraph.
	Live stock Chicago (code)	....do....	12.00 noon	4000meters,arc undamped.
	....do....	....do....	5.00 p. m.	Do.
	Live stock, Kansas City	....do....	8.00 p. m.	Do.
	Live stock, Omaha, Nebr.	....do....	8.30 p. m.	Do.
Omaha, Nebr.: Air mail radio station, KDEF.	Live stock receipts (code)	....do....	9.00 a. m.	Telegraph.
	Live stock, Chicago (code)	....do....	11.00 a. m.	2500 met. arc undamped.
	Live stock, Omaha (code)	....do....	12.00 noon	Do.
	Live stock, Kansas City (code)	....do....	1.00 p. m.	Do.
	Grain, Omaha (code)	....do....	2.00 p. m.	Do.
	Live stock, Chicago	....do....	4.30 p. m.	Do.
	Live stock, Kansas City	....do....	7.00 p. m.	Do.
	Live stock, Omaha	....do....	7.30 p. m.	Do.
			Eastern time.	
Pittsburgh, Pa. (East Pittsburgh) Westinghouse Electric Manufacturing Co., KDKA.	Fruit and vegetable (Pittsburgh), live stock (Chicago), grain.	Federal	7.45 p. m.	Phone.
	Chicago, hay and feed	Local	7.45 p. m.	Do.
			Pacific time.	
Reno, Nev.: Air mail radio station, KDEK.	Live stock receipts (code)	Federal	9.00 a. m.	Telegraph.
	Live stock, Chicago (code)	....do....	1.00 p. m.	3200 met., arc undamped.
			Central time.	
Richmond, Ind.: Palladium Printing Co., WOZ.	Indianapolis markets	Local	12.00 noon	Phone.
	Weather forecast	Federal	4.00 p. m.	Do.
	Complete market report	Local	4.00 p. m.	Do.
	Weather, local news, music	Federal and local.	6.30 p. m.	Do.
			Eastern time.	
Rochester, N. Y.: Rochester Times Union, WHQ.	New York State market reports	State	7.45 p. m.	Do.
			Mountain time.	
Rock Springs Wyo.: Air mail radio station, KDHN.	Live stock receipts (code)	Federal	9.00 a. m.	Telegraph.
	Live stock, Chicago (code)	....do....	12.00 noon	3000 met., arc undamped.
	Live stock, Chicago	....do....	4.30 p. m.	Do.
	Live stock, Kansas City	....do....	8.00 p. m.	Do.
	Live stock, Omaha	....do....	8.30 p. m.	Do.
			Eastern time.	
Schenectady, N. Y.: General Electric Co., WGY.	New York City market fruit and vegetables, butter, eggs, poultry, hay, and country dressed meat.	State	7.00 p. m.	Phone.
St. Louis, Mo.:			*Central time.*	
St. Louis University, WEW.	Market report, live stock receipts St. Louis and Chicago hog opening (code).	Federal	10.15 a. m.	Do.
	St. Louis and Kansas City opening, trend of market, Liverpool cables.	....do....	10.15 a. m.	Do.
	Fruit and vegetable, Chicago potatoes, live stock, St. Louis close, closing grain market.	....do....	2.15 p. m.	Do.
	Market reports Saturday	....do....	1.00 p. m.	Do.
Stix-Baer & Fuller Co., WCK.	Merchants Exchange reports, opening future market.	Local	8.40 a. m.	Do.
	Future market receipts and shipments	....do....	9.40 a. m.	Do.
	Future market	....do....	10.40 a. m.	Do.
	....do....	....do....	11.40 a. m.	Do.
	Closing future market cash grain prices	....do....	12.40 p. m.	Do.
			Eastern time.	
Springfield, Mass.: Westinghouse Electric & Manufacturing Co., WBZ.	Weather forecast	Federal		Do.
	Massachusetts State market reports	State		Do.
			Mountain time.	
State College, N. Mex.: New Mexico College of Agriculture and Mechanical Arts, KOB.	Time signals	Federal	11.55 a. m.	Do.
	Weather forecast	....do....	12.00 noon	Do.
	Crop reports	....do....	12.05 p. m.	Do.
	Music and entertainment	Local	8.00 p. m.	Do.
			Eastern time.	
Tampa, Fla.: Tampa Daily Times, WDAE.	Information not available			Do.
			Eastern time.	
Toledo, Ohio: The William B. Duck Co., WHU.	Grain market (Toledo)	State	9.40–12.30 and 1.40	Do.
	Live stock and vegetables	....do....	12.30 p. m.	Do.
	Baseball and news	....do....	5.00 p. m.	Do.
	Musical entertainment Tuesday and Thursday.	Local	9.00 p. m.	Do.

(*Continued on next page.*)

Federal Radio Body

At the request of the Secretary of Commerce each of the ten Government departments have appointed representatives on an Interdepartment Advisory Committee on Governmental Radio Broadcasting. There are, in addition, representatives of the office of the chief coordinator, Bureau of the Budget, and the United States Shipping Board. The membership of the committee is as follows: Agriculture, W. A. Wheeler, Radio Development Section; Commerce, Dr. S. W. Stratton, director, Bureau of Standards; Interior, O. P. Hood, chief mechanical engineer, Bureau of Mines; Justice, S. Ely, chief clerk; Labor, A. E. Cook, office of the Secretary; Navy, Commander D. C. Bingham, Naval Communication Service; Post Office, J. C. Edgerton, air mail division; State, W. S. Rogers, International Communications Conference; Treasury, L. J. Heath, Public Health Service; War, Maj. Gen. G. O. Squier, chief signal officer; Chief Coordinator, Capt. H. P. Perrill, assistant coordinator, Bureau of the Budget; United States Shipping Board Emergency Fleet Corporation, F. P. Guthrie, head of radio division, operating department.

The chairman of the committee is Dr. S. W. Stratton and the secretary is Dr. J. H. Dellinger, chief of the radio laboratory, Bureau of Standards, Department of Commerce. In accordance with recommendations of the committee an experimental system of Government broadcasting by "primary" broadcast stations has been established, utilizing only previously existing Government stations and equipment. The "primary" stations are stations which broadcast official Government news by continuous wave (code) telegraphy for the purpose of furnishing this information to local broadcast stations for rebroadcasting by radiophone. The eight stations thus far included send out daily bulletins of Government news, mostly agricultural market data. They are: Arlington, Va. (Navy, 5950 meters), Great Lakes, Ill. (Navy, 4900 meters), Washington, D. C. (Post Office, 1980 meters), Omaha, Nebr. (Post Office, 2500 meters), North Platte, Nebr. (Post Office, 4000 meters), Rock Springs, Wyo. (Post Office, 3000 meters), Elko, Nev. (Post Office, 3000 meters), Reno, Nev. (Post Office, 3200 meters).

The committee has recognized the principle that radio must be used, primarily, for types of service that can not be as satisfactorily given by other means of communication, and that therefore radio broadcasting should not be used in general where wire telegraphy or telephony or printed publication would be as satisfactory. It is possible that the scope of the committee's activities may be extended beyond the subject of broadcasting, and that the committee will act in an advisory capacity to the Secretary of Commerce in matters of Government radio regulation and will consider all radio questions of interdepartmental interest.—*Submitted by Bureau of Standards.*

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1st Regiment Armory

CHICAGO

JAN. 13 to 20

***1923* (incl.)**

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January is the ideal month for perfect radio reception, also the time when inventories have been made thereby enabling dealers to buy with intelligence and safety.

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for Diagram

Second National Radio Exposition

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CHICAGO

Federal, State, and private market reports—Continued.

Name and call letters of station.	Nature of reports.	Source.	Time of transmission.	Type of transmission.
			Central time.	
Tulsa, Okla.: Midland Refining Co., WAH.	Live stock reports	Federal	10.30 a. m. and 1.30 p. m.	Do.
	Weather forecast	do	10.30 a. m. and 3.30 p. m.	Do.
	Concerts (not regular)	Local	7.45 p. m.	Do.
			Central time.	
University Place, Nebr.: Nebraska Wesleyan University, WCAJ.	Weather forecast and news	Federal and local.	8.50 a. m.	Phone.
	Omaha live stock, Chicago grain (code and press).	Federal	4.00 p.m. daily 12.15 p. m. Saturday.	Do.
	Concerts, lectures, etc., Tuesday and Thursday.	Local	9.30 p. m.	Do.
			Eastern time.	
Washington, D.C. Fruit and vegetable (Washington, D. C.)		Federal	10.30 a. m.	Phone, 1160 meters.
Post Office Department airmail radio station, WWX.	Live stock receipts and St. Louis and Chicago hog opening (code).	do	12.30 p. m.	Do.
	Live stock, Chicago and St. Louis close (code).[1]	do	2.15 p. m.	Do.
	Crop reports and special market news.[1]	do	3.00 p. m.	Do.
	General fruits and vegetables[1]	do	3.30 p. m.	Do.
	Dairy products, New York and Chicago (code[1].)	do	5.00 p. m.	Do.
	Grain[1]	do	5.30 p. m.	Do.
	Live stock and grain (code)[1]	do	7.30 p. m.	Do.
	Fruit and vegetable[1]	do	8.00 p. m.	Do.
Wichita, Kans.: The Cosradio Co., WEY.	Board of trade reports; information not available.			Phone.

[1]Not broadcasted on Saturday from June 15 to Sept. 15.
NOTE.—When no form number is indicated straight copy is used.

SPECIAL LAND STATIONS

Special land stations, alphabetically by names of stations.
[Additions to the List of Radio Stations of the United States, edition of June 30, 1921.]

Station.	Call signal.	Wave lengths.	Station controlled by—
Abilene, Tex.	5ZAX	*200*,375	Eugene W. Wood, 340 Butternut Street.
Atlanta, Ga.	4X1	*200*,275	Technological High School
Belmar, N. J.	2XAO	Variable	Radio Corporation of America, 233 Broadway, New York, N. Y.
Dallas, Tex.	5ZAY	*200*,375	A. H. Belo & Co.
Delanco, N. J.	3XP	250	Henry M. Neely.
Fayetteville, Ark.	5ZAZ	*200*,375	Lawrence W. Stinson, 354 North West Street.
Great Neck, N. Y.	2XAN	Variable	Harry Alexander, 20 West Thirty-fourth Street, New York, N. Y.
Madison, Wis.	9XL	360	North Western Radio Co., 250 State Street.
Mobile, Ala.	5XAE	*200*,375	Mobile Radio Co., O'Gwinn Building.
New Brunswick, N. J.	2XAM	Variable	Radio Corporation of America, 233 Broadway, New York, N. Y.
Oklahoma City, Okla.	5XAF	*200*,375	Roswell B. Downing.
Orange, Tex.	5XAD	Variable	Gray & Gray.
Philadelphia, Pa	3XAG	*200*,250	Westinghouse Electric & Manufacturing Co., 214 North Twenty-second Street.
Pittsburgh, Pa.	8XW	Variable	Radio Electric Co., 1427 Liberty Avenue.
Pittsburgh, Pa.	8XX	*200*,375	Duquesne University.
San Francisco, Calif.	6XAU	Variable	Wilson McQuire Co., 1004 Treat Avenue.
Tampa, Fla.	4XJ	285,325	Thompson Electric Co., 102 West Lafayette Street.
Washington, D. C.	3XO	*200*,375	Central High School.
Waterbury, Conn.	1XT	360	Bristol Co.
Winthrop, Mass.	1XQ	Variable	Lloyd C. Greene, 88 Somerset Avenue.
Worcester, Mass.	1XS	do	Otis C. White, 17 Herman Street.

Special land stations, grouped by districts.

Call signal.	District and Station.	Call signal.	District and station.
	First district:		Fifth district:
1XQ	Winthrop, Mass.	5XAD	Orange, Tex.
1XS	Worcester, Mass.	5XAE	Mobile, Ala.
1XT	Waterbury, Conn.	5XAF	Oklahoma City, Okla.
	Second district:	5ZAX	Abilene, Tex.
2XAM	New Brunswick, N. J.	5ZAY	Dallas, Tex.
2XAN	Great Neck, N. Y.	5ZAZ	Fayetteville, Ark.
2XAO	Belmar, N. J.	6XAU	Sixth district: San Francisco, Calif.
	Third district:		Eighth district:
3XAG	Philadelphia, Pa.	8XX	Pittsburgh, Pa.
3XO	Washington, D. C.	8XW	Do.
3XP	Delanco, N. J.	9XL	Ninth District: Madison, Wis.
	Fourth district:		
4X1	Atlanta, Ga.		
4XJ	Tampa, Fla.		

Federal Act Regulating Radio

Measure Now Pending in United States Senate Committee on Interstate Commerce

Mr. Kellogg introduced the following bill; which was read twice and referred to the Committee on Interstate Commerce.

A BILL

To amend an Act to regulate radio communication, approved August 13, 1912, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled. That the Act of Congress entitled "An Act to regulate radio communication," approved August 13, 1912, is amended by striking-out sections 1, 2 and 3 thereof and by inserting in lieu thereof the sections 1, 2 following:

"Section 1. A. That no person, company or corporation within the jurisdiction of the United States shall use or operate any apparatus for radio communication by telegraphy or telephony as a means of intercourse among the several States or with foreign nations, or upon any vessel of the United States engaged in interstate or foreign commerce, or for the transmission of radiograms or signals by telegraphy or telephony the effects of which extend beyond the jurisdiction of the State or Territory in which the same are made, or where interference would be caused thereby with the transmission or reception of messages or signals from beyond the jurisdiction of said State or Territory, except under and in accordance with a license in that behalf granted by the Secretary of Commerce and except as hereinafter authorized.

"B. That the Secretary of Commerce from time to time shall (a) classify licensed radio stations and the operators required therein; (b) prescribe the nature of the service to be rendered by each class of licensed station and assign bands of wave lengths thereto; (c) make, alter, and revoke regulations applicable to all licensed stations not inconsistent with this Act or any other Act of Congress or with the terms of any radio communication convention to which the United States is a party concerning the service to be rendered by each class of stations so established; the location of any station; the wave lengths to be used by any station; the kinds of instruments or apparatus in any station with respect to the external effect produced thereby; the power and the purity and sharpness of the waves of each station or the apparatus therein; the area to be served by any station and the times and methods of operating any station or the apparatus therein; (d) make such other regulations not inconsistent with law as he may deem necessary to prevent interference between all stations affected by this Act.

"C. That radio stations belonging to and operated by the United States and used exclusively for communications of official business, shall not be subject to the provisions of paragraphs A and B of this section. Every other station owned and operated by the United States shall be subject to the provisions of said paragraphs A and B of this section. All stations owned and operated by the United States and all other licensed stations on land and sea shall have special call letters designated by the Secretary of Commerce, and such stations and the designated call letters shall be included in the list of radio stations of the United States as published by the Department of Commerce. Radio stations owned and operated by the United States and used exclusively for the communication of official business shall use such wave lengths as shall be assigned to each by the President, and shall observe such regulations as the Secretary of Commerce may make to prevent undue interference with other radio stations and rights of others, except that upon proclamation by the President that there exists war or a threat of war or a state of public peril or disaster or other emergency, the President may suspend for such time as he may see fit all such regulations of the Secretary of Commerce applicable to such stations owned and operated by the United States.

"D. That every such license shall provide that the President of the United States in time of war or public peril or disaster, may cause the closing of any station for radio communication and the removal therefrom of all radio apparatus or may authorize the use or control of any such station or apparatus by any department of the Government upon just compensation to the owners.

"Sec. 2. A. That paragraph A of Section 1 of this Act shall not apply to persons sending radio messages or signals through a radio station belonging to and operated by the United States for the transmission exclusively of official business nor to persons sending such messages on a foreign ship while the same is within the jurisdiction of the United States.

"B. That the station license required hereby shall not be granted to, or after the granting thereof such license shall not in any manner, either voluntarily or involuntarily, be transferred to (a) any alien or the representative of any alien; (b) nor to any foreign government or the representative thereof; (c) nor to any company, corporation, or association organized under the laws of any foreign government; (d) nor to any company, corporation, or association of which any officer or director is an alien or of which more than one-fifth of the capital stock shaving voting power is owned or con trolled by aliens or their representatives or by a foreign government of representative thereof, or by any company, corporation, or association organized under the laws of a foreign country.

"Such station license, the wave length or length authorized to be used by the licensee, and the rights therein granted shall not be transferred, assigned, or in any manner, either voluntarily or involuntarily, disposed of to any other person, company, or corporation without the consent in writing of the Secretary of Commerce.

"C. That the Secretary of Commerce, subject to the limitations of this Act, in his discretion, may grant to any applicant therefor a station license provided for in Sections 1 and 2 hereof, except that he may grant such license only to a station which is in the interest of the general public service.

"No license granted by the Secretary shall be for a longer term than 10 years, and any license granted may be revoked as hereinafter provided. Upon the expiration of any license the Secretary, in his discretion upon application therefor, may grant a renewal of such license for the same or for a lesser period of time.

"The Secretary of Commerce is hereby authorized to refuse a license to any person, company, or corporation, or any subsidiary thereof which, in the judgment of the Secretary, is monopolizing or seeking to monopolize radio communication, directly or indirectly, through the control of the manufacture or sale of radio apparatus or by any other means. The granting of a license shall not estop the United States from prosecuting such person, company, or corporation, for a violation of the law against monopolies or restraint of trade.

"D. That the Secretary of Commerce may grant licenses only upon written application therefor addressed to him, which application shall set forth such facts as he by regulation may prescribe as to the citizenship, character, and financial, technical, and other ability of the applicant to operate the station; the ownership and location of the proposed station and of the stations with which it is proposed to communicate; the wave lengths and the power desired to be used; the hours of the day or other periods of time during which it is proposed to operate the station; the purposes for which the station is to be used, and such other information as he may require. Such application shall be signed by the applicant under oath or affirmation.

"E. That such station license as the Secretary of Commerce may grant shall be in general form as he may prescribe, but each license shall contain in addition to other provisions a statement of the lolowing conditions to which such license shall be subject: (a) The ownership or management of the station or apparatus

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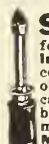

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therein shall not be transferred in violation of this Act. There shall be no vested property right in the license issued for such station or in the bands of wave length authorized to be used therein, and neither the license nor any right granted thereunder shall be assigned or otherwise transferred in violation of the Act; (b) such licenses shall contain such other conditions not inconsistent with this Act, as the Secretary of Commerce may prescribe.

"F. That any station license granted by the Secretary of Commerce shall be revocable by him for failure to operate service substantially as proposed in the application and as set forth in the license, for violation of or failure to observe any of the restrictions and conditions of this Act or of any regulation of the Secretary of Commerce authorized by this Act or by the provisions of any international radio convention ratified or adhered to by the United States or any regulations thereunder, or whenever the Secretary of Commerce shall deem such revocation to be in the public interest; *Provided*, That no order of revocation shall take effect until thirty days' notice in writing thereof to the parties known by the Secretary to be interested in such license. Any person in interest, aggrieved by said order, may make written application to the Secretary at any time within said thirty days for a hearing upon such order and upon the filing of such written application said order of revocation shall stand suspended until the conclusion of the hearing herein directed. Notice in writing of said hearing shall be given by the Secretary to all the parties known to him to be interested in such license twenty days, prior to the time of said hearing. Said hearing shall be conducted under such rules and in such manner as the Secretary may prescribe. Upon the conclusion thereof the Secretary may affirm, modify, or revoke said orders of revocation.

"Sec. 3. A. That the actual operation of apparatus in any radio station for which a station license is required by this Act shall be carried on only by a person holding an operator's license issued thereunder. No person shall operate any apparatus in such station except under and in accordance with an operator's license issued to him by the Secretary of Commerce.

"B. That the Secretary of Commerce, in his discretion, may grant special temporary operators' licenses to operators of radio apparatus under such regulations, in such form, and upon such conditions as he may prescribe whenever an emergency arises requiring prompt employment of such an operator.

"C. That an operator's license shall be issued by the Secretary of Commerce in response to a written application therefor, addressed to him, which shall set forth (a) the name, age, and address of the applicant; (b) the date and place of birth; (c) the country of which he is a citizen; and if a naturalized citizen of the United States, the date and place of naturalization; (d) the previous experience of the applicant in operating radio apparatus; and (e) such other facts or information as may be required by the Secretary of Commerce. Every application shall be signed by the applicant under oath or affirmation.

"D. That an operator's license shall be issued only to a person who, in the judgment of the Secretary of Commerce, is proficient in the use and operation of radio apparatus and in the transmission and reception of radiograms by telegraphy and telephony. Except in an emergency found by the Secretary of Commerce to exist, an operator's license shall not be granted to any alien, nor shall such a license be granted to a representative of a foreign government.

"E. That an operator's license shall be in such form as the Secretary of Commerce shall prescribe, and may be suspended by him for a period not exceeding two years upon proof sufficient to satisfy him that the licensee: (a) has violated any provision of any act or treaty which the Secretary of Commerce is authorized by this Act to administer, or of any regulation made by the Secretary under any such Act or treaty; or (b) has failed to compel compliance therewith by any unlicensed person under his supervision; or (c) has failed to carry out the lawful orders of the master of the vessel on which he is employed; or (d) has wilfully damaged or permitted apparatus to be damaged; or (e) has transmitted superfluous signals, or signals containing profane or obscene words or language.

"F. That a license may be revoked by the Secretary of Commerce upon proof sufficient to satisfy him that the licensee was at the date his license was granted to him, or is at the time of revocation, ineligible for a license.

"Sec. 4. A. That after the approval of this Act the construction of a station for which a license is required by this Act shall not be begun, nor shall the construction of a station already begun be continued, until after a permit for its construction has been granted by the Secretary of Commerce upon written application therefor. This application shall set forth such facts as the Secretary of Commerce by regulation may prescribe as to the citizenship, character, and the financial, technical, and other ability of the applicant to construct and operate the station, the ownership and location of the proposed station and of the station or stations with which it is proposed to communicate, the wave or wave lengths desired to be used, the hours of the day or other periods of time during which it is proposed to operate the station, the purpose for which the station is to be used, the type of transmitting apparatus to be used, the power to be used, the date upon which the station is expected to be completed and in operation and such other information as the Secretary of Commerce may require. Such application shall be signed by the applicant under oath or affirmation.

"B. That such permit for construction shall show specifically the earliest and latest dates between which the actual operation of such station is expected to begin and shall provide that said permit will be automatically forfeited if the station is not ready for operation within

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the time specified. The rights granted under any such permit shall not be assigned or otherwise transferred to any other person, persons, company, or corporation, without the approval of the Secretary of Commerce: *Provided*, That a permit for construction shall not be required for Government stations to be used exclusively for communication of official business or for private stations as provided for in Section 4, fifteenth regulation, of the Act of August 13, 1912. The granting of this permit to construct a station as herein required shall not be construed to impose any duty or obligation upon the Secretary to issue a license for the operation of such station.

"Sec. 5. That an advisory committee is hereby established to whom the Secretary of Commerce shall refer for examination and report such matters as he may deem proper relating to: (a) the administration or changes in the laws, regulations, and treaties of the United States relating to radio communication; (b) the study of the scientific problems involved in radio communication with the view of furthering its development; (c) the scientific progress in radio communication and use of radio communication.

"The advisory committee shall consist of twelve members, of whom one shall be designated by the Secretary of State, one by the Secretary of War, one by the Secretary of the Navy, one by the Secretary of Agriculture, one by the Postmaster General, and one by the Secretary of Commerce, to represent these departments, respectively, and six members of recognized attainment in radio communication not otherwise employed in the Government service to be designated by the Secretary of Commerce.

"The necessary expenses of the members of the committee in going to, returning from, and while attending meetings of the committee, including clerical expenses and supplies, together with a per diem of $25 to each of the six members not otherwise employed in the Government service for attendance at the meetings, shall be paid from the appropriation made to the Department of Commerce for this purpose.

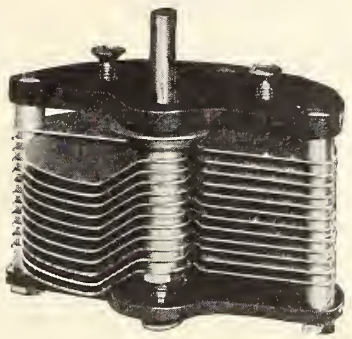
"Sec. 6. That radio telephone stations, the signals of which can interfere with ship communication, are required to keep a licensed radio operator, of a class to be determined by the Secretary of Commerce, listening in on the wave length designated for distress signals during the entire period the transmitter of such station is in operation.

"Sec. 7. That regulation first of Section 4 of said Act of Congress approved August 13, 1912, is amended by striking out the words 'this wave length shall not exceed six hundred meters.'

"Regulations third and fourth of Section 4 Act of Congress approved August 13, 1912, is amended by striking out the words 'provided that they do not exceed six hundred meters or that they do exceed one thousand six hundred meters.'

"Regulations third and fourth of Section 4 of said Act of Congress approved August 13, 1912, are amended by striking out the words 'exceeding two hundred meters' and substituting in lieu thereof

Variable Condensers



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SPECIAL OFFER: 5,000 will be sold direct to users at factory prices in order to introduce. This is an opportunity to save money on the best Radio battery ever produced. Some Combata have given as high as 8 years, continuous service. Great length of life more than makea up for any difference in price. Take advantage of this offer NOW. Act Quick to Buy at These Prices.

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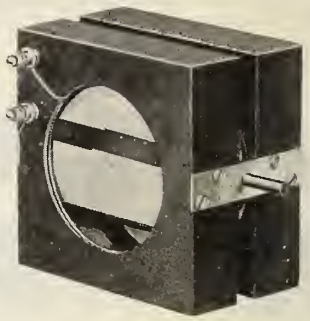
the words 'of not less than one hundred and fifty meters nor more than two hundred and seventy-five meters.'

"Sec. 8. That any person, company, or corporation who shall erect, use, or operate any apparatus for radio communication in violation of this Act, or knowlingly aid or abet another person, company, or corporation, in so doing, or knowingly make false oath or affirmation for the purpose of securing a permit or a license, shall incur a penalty not to exceed $1,000, which may be mitigated or remitted by the Secretary of Commerce, and the permit or license of any person, company, or corporation, who shall violate any of the provisions of this Act, or of any of the regulations of the Secretary of Commerce issued hereunder, or knowingly make any false oath or affirmation for the purpose of securing a permit or license, may be suspended or revoked by the Secretary of Commerce.

"Sec. 9. That the Secretary of Commerce is hereby authorized and directed to charge, and through the imposition of stamp taxes on applications, licenses, or other documents, or in other appropriate manner, to collect, the fees specified in the schedule following. The Secretary shall collect said fees through the collectors of customs or other officers designated by him, and he may make such regulations as may be necessary to carry out the provisions of this section."

"For trans-oceanic radio station license $300 per annum; for commercial land station license, other than trans-oceanic, one kilowatt transmitter input or less, $50 per annum; and for each additional kilowatt or fraction thereof, $5 per annum; for ship station license, $25 per anper annum; for experiment station license, $25 per annum; for technical and training school station license, $15 per annum; for special amateur station license, $10 per annum; for general and restricted amateur station license, $2.50 per annum; for commercial extra first-class operator's license, $2.50 per annum; for commercial first-class operator's license, $1.50 per annum; for commercial second-class operator's license, $1 per annum; for commercial cargo grade operator's license, 50 cents per annum; for experiment and instruction grade operator's license $1 per annum; for amateur first-grade operator's license, 50 cents per annum; for amateur second-grade operator's license, 50 cents per annum; for commercial extra first-class radio operator's examination for license, $2.50 for each examination; for commercial first-class radio operator's examination for license, $2 for each examination; for commercial second-class radio operator's examination for license, $1.50 for each examination; for commercial cargo grade radio operator's examination for license, $1 for each examination; for experiment and instruction grade radio operator's examination for license, $1 for each examination; for amateur first-grade radio operator's examination for license, $1 for each examination; for amateur second-grade operator's examination for license, 50 cents for each examination.

VARIOMETER



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Rotor and stator in moulded hard rubber, highly finished, best insulation known. Beautiful design binding posts, eliminating any necessity of soldering. Finished product. Wound with green covered wire; nickel plated hardware. Put up in attractive boxes.

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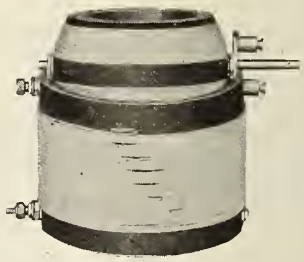

$4.59

Tube of hard fibre, rotor in moulded hard rubber. Wound with green covered wire. Nickel plated hardware. Special binding posts. No soldering of connections.

The set herewitb illustrated is a four tube Radio-frequency set built into a light-weight, portable case with nickel-plated hardware, making a handsome, simple and salable set. Prices on sets range from **$65.00** to **$190.00**, including tubes, B Batteries and head phone. These sets can be taken wherever you go, being light and convenient to carry.

VARIABLE CONDENSERS

Aluminum plates, fibre and brass end pieces. Sturdily and well constructed.

11 plates	$3.00
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3-in. Dials and composition sockets of attractive design at 75c each. Rheostats with pointer, $1.10; with dial $1.50

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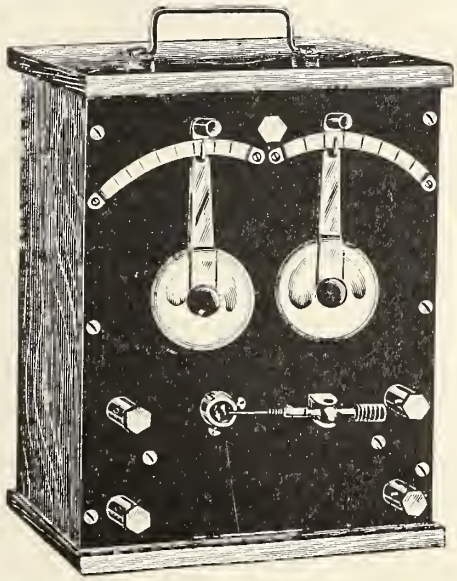
THIS instrument is assembled in a walnut cabinet with a highly polished Bakelite front, all metal parts highly nickeled.

The Crystal Detector is of the very latest pattern, with ball and socket arrangement, so same can be moved up and down, sidewise and forward and back so that the most sensitive point on the Galena can be located.



The Galena retainer is of standard size so that all mounted Galenas will fit it.

The size of the set is as follows: Height, 10 inches; width, 8 inches; depth, 6½ inches.

There are two tuning levers on the front. After locating the most sensitive point of the Galena the two levers are moved back and forth until the best result is obtained.

This receiving set WILL NOT receive messages from great distances but it works perfectly under favorable conditions from 15 to 25 miles away from the broadcasting station.

Each receiving set is guaranteed to be in perfect condition, being thoroughly tested before accepted from the factory.

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FREE

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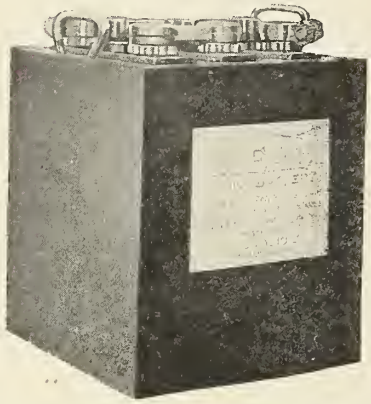

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CAPACITY: 6 VOLT, 50 AMPERES

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RADIO AGE

The Magazine of the Hour

October, 1922

Price 25 cents

How To Make a Tube Unit for $23—In This Number

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Please remember that Radio Age has one of the best radio instructors in the United States, who is ready to answer any technical question. This costs you nothing.

RADIO AGE

The Magazine of the Hour

Volume 1 *Number 5*

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Pardon Our Loud Speaker

One day we visited a Radio Show in the Central West. Several exhibitors had loud speakers installed in their booths and each one, apparently fearing the other fellow would get the most attention, turned on the noise to the limit. Friends, it was awful. The bedlam gave us such an unfortunate impression of Radio entertainment?? that we put our own loud speaker away in the kitchen cabinet when we arrived back home.

We are bringing it out again because we have something which calls for a bit of noise and we want to broadcast it.

Radio magazines are not newspapers. However, some Radio magazines publish articles about the progress of wireless developments that are real news stories. With becoming modesty we call attention to the fact that RADIO AGE has been printing Radio News first. And Radio News which is not printed first is not news at all.

In our August issue we published articles on "Radio Equipment at KDKA", and on "Development of Radiophone Broadcasting" both by eminent experts. We are not betraying any confidences when we tell our readers that we observed the same articles in the September issue of other magazines. Also in the August number we published an article on "How Radio Photographs Crossed the Atlantic in 40 Minutes". This article was accompanied by an illustration on our first page. Imagine our satisfaction in having our selectivity endorsed by no less a periodical than the Litry Digest in the following September. The Digest folks not only used a story about the same Radio achievement but they printed the same illustration.

In the September number of RADIO AGE we printed an article on "The Problem of Radio Power Transmission". We find the same article in the October number of another Radio monthly.

In this number of RADIO AGE we are publishing in full a Bureau of Standards Official article on How to Build a Tube Unit accompanied by seven illustrations. We note that at least two other Radio periodicals are advertising that they will publish this same Bureau of Standards article *next month.*

Before turning off the Loud Speaker let us broadcast the News that some of the best judges of Radio writing in the United states have been telling us by letter, unsolicited, that Mr. Pearne's September article on the Reinartz Unit was the bulliest thing in type anywhere on this subject.

Read RADIO AGE if you want Radio News.

Tuning In For Grandma

William McClintock, 108 West Madison street, Chicago, not only built this receiving outfit with which he hears broadcasting stations within a radius of more than 1,000 miles, but he is the father of the little radio fan in the big chair. And Mr. McClintock took the photograph. Seems like Bill has lots of reasons to be proud of himself.

RADIO AGE
"The Magazine of the Hour"
M. B. SMITH
PUBLISHER
PUBLISHED MONTHLY GARRICK BLDG CHGO.
FREDERICK SMITH
EDITOR

How to Make a Tube Unit for $23 to $37, with Radius of 75 Miles

Beginners Told by Uncle Sam's Experts How to Take the Next Step Beyond the Crystal Set

USE of an electron tube detector will increase the receiving radius of the receiving set so that it will be possible to hear high power transmitting stations at a distance of about seventy-five miles. Under good atmospheric conditions signals from greater distances may be heard, especially at night.

The electron tube detector may be substituted for the crystal detector, that is, its function is the same as the crystal detector, which is to make the signals from the transmitting station audible in the telephone receivers when the radio receiving set is tuned to the proper wave frequency (wave length).

This article brings the amateur one step forward in understanding the more complex and sensitive apparatus. If the reader has a crystal set the article will enable him to use this more efficient detector. A later article will describe how to use amplifiers. It should be remembered that the electron tube detector will not make "continuous wave" signals audible.

The following description of the electron tube detector, with the illustrations, were supplied to Radio Age by the Bureau of Standards, United States Department of Commerce and is published with permission of the Government. Readers, therefore, will be assured that they are following instructions given by foremost experts in radio.

If any reader meets difficulty in making this unit, he may send self-addressed and stamped envelope to Frank D. Pearne, Technical Editor of Radio Age, 64 West Randolph Street, Chicago, and a prompt reply will be sent back. This is only a

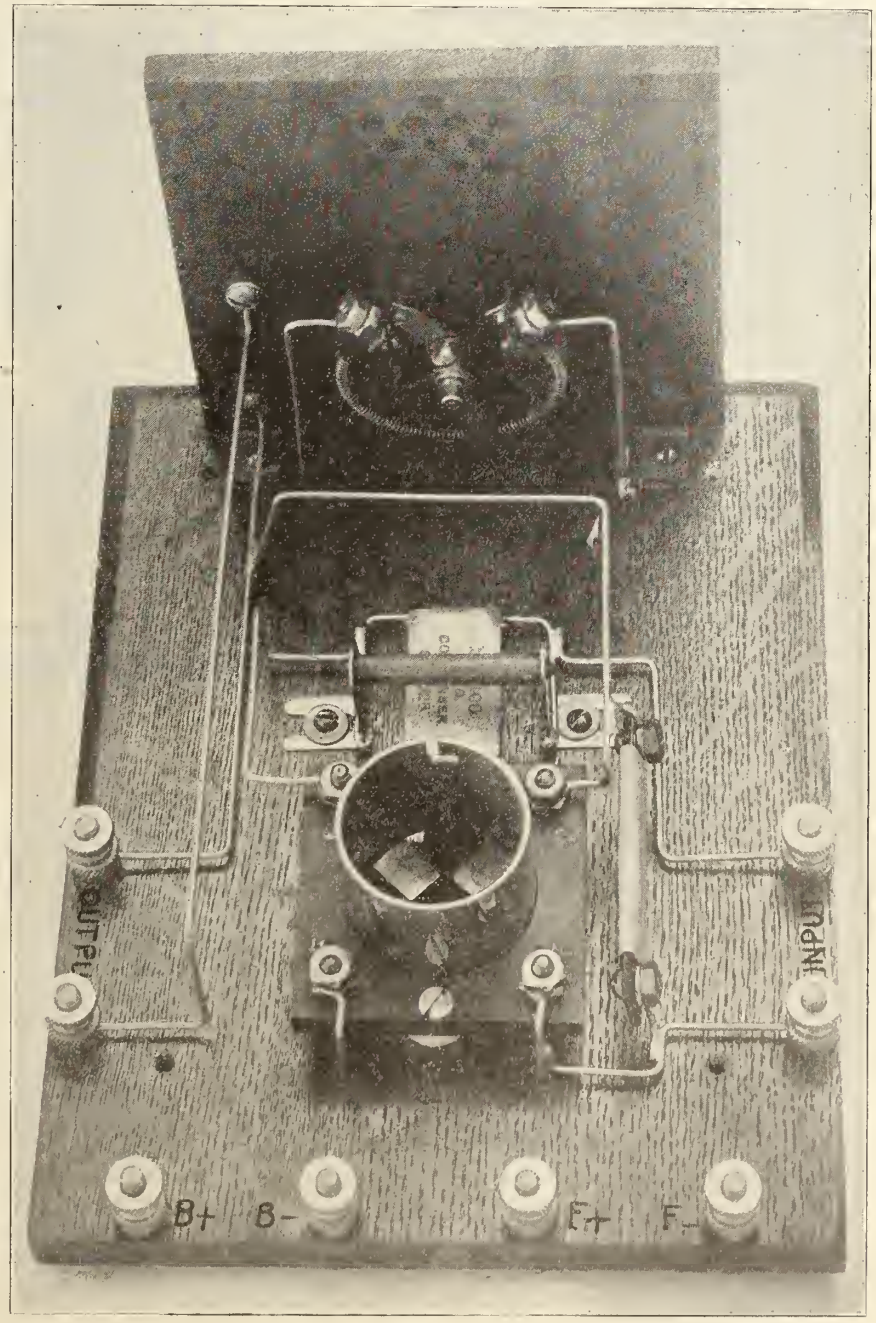


FIG. 2.

part of the service department which this magazine has established for the assistance and convenience of its readers.

The cost of an electron tube detector unit, complete with the necessary batteries will be between $23.00 and $37.00. Additional electron tube amplifiers described in subsequent articles, which will greatly increase the sensitivity and hence the receiving radius of the receiving set, will not require additional storage batteries. This will make the added cost of the amplifiers small.

This article describes simple apparatus of satisfactory performance without reference to the possible existence of any patents which might cover parts of the apparatus. Apparatus in general similar to that described can be purchased from responsible manufacturers.

Essential Parts

The complete r a d i o receiving equipment may be divided as follows: Antenna, lightning switch, ground connections and telephone receivers. These are completely described in Bureau of Standards Circular, No. 120, published in the May issue of Radio Age.

The Tuning Device.—This may be the tuning coil described in Circular No. 120 or it may be a two-circuit coupler and variable condenser. While the two-circuit tuner will be somewhat more selective than the single-circuit tuner, its use is not absolutely essential. The two-circuit tuner is also more difficult to operate than the single-circuit tuner.

Electron Tube Detector Unit. (Figs. 1, 2, and 7).—The electron tube detector unit is composed of a baseboard B and an upright panel A. On the baseboard B is mounted an electron tube E, (shown only in Fig. 7), an electron tube socket S, a resistor (grid leak) R, a grid condenser C, a by-pass condenser C′, and eight binding posts. On the upright panel A is mounted a filament rheostat R′, (the adjusting knob J is shown in Fig. 7), and two telephone receiver binding posts L and M. The parts S, R, C and C′ are also shown in Fig. 3. This circular tells how the various parts are assembled on the baseboard and the panel. No description is given of how the parts E, S and R′ are made because these are all commercial articles. It is, of course, possible for one to make parts such as the electron tube socket S and the filament rheostat R′.

Accessories.—Under the heading of accessories may be listed a six-volt battery, used for lighting the filament, often called the "A" battery, having an ampere-hour capacity of about 60, a 22 1-2 to 45-volt dry battery ("B" Battery) binding posts, stiff copper wire, wood boards for the baseboard and upright panel, and two brass angle braces for supporting the panel. The "A" and "B" batteries are shown in Fig. 7. The "A" battery will usually be placed on the floor beneath the table upon which the other parts of the equipment are mounted. Its comparative size is much reduced in the drawing. An insulating material panel may be substituted for the wood if desired. The electron tube detector may also be entirely enclosed in a wood cabinet with a hinged cover, if desired.

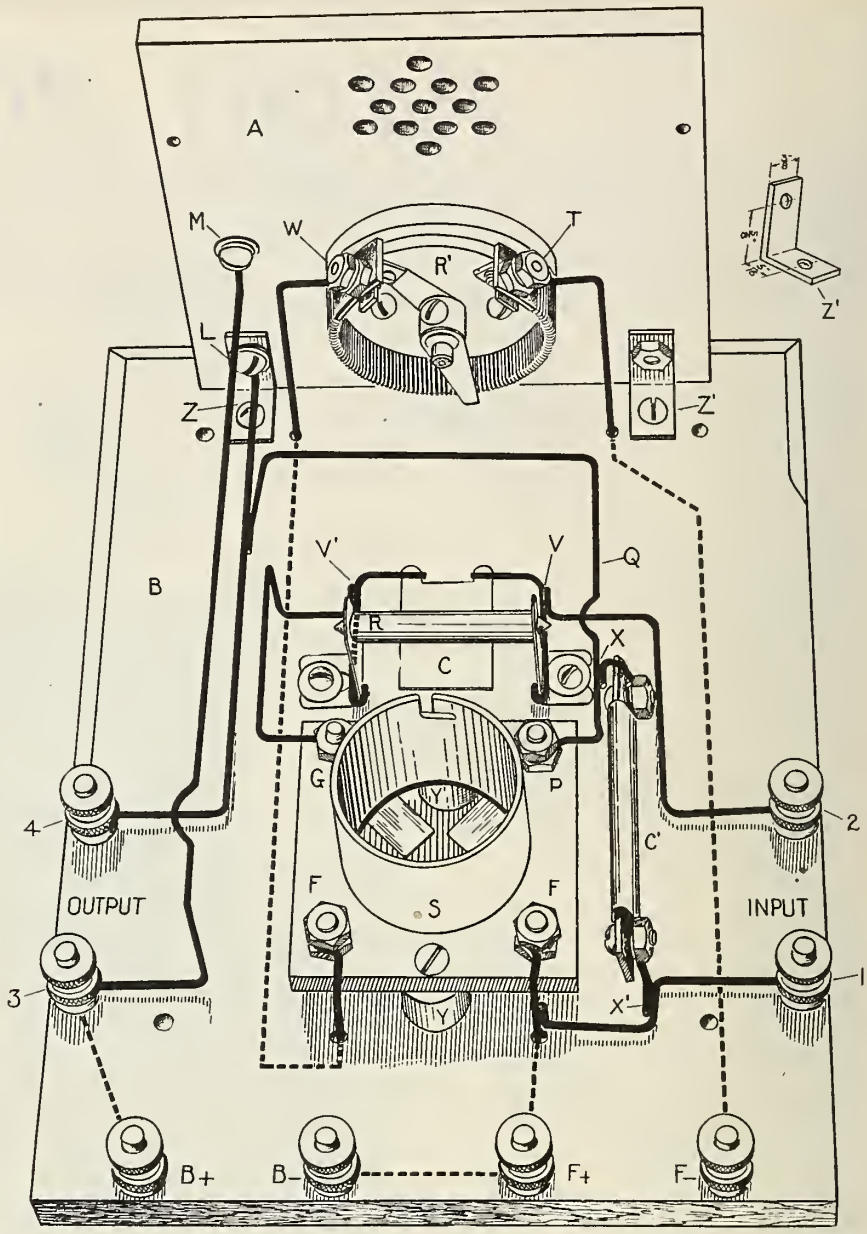


FIG. 1.

Details of Construction

Baseboard. (B Figs. 1 and 3).—The base B is any kind of dry wood about 6 1/4 inches by 8 1/4 inches by 3/4 inch thick. Eight holes are drilled through the base in which the binding posts are fastened. Spacing of these holes is shown in Fig. 3. By the addition of two more binding posts properly connected, this detector may be used in a "regenerative" circuit when the binding posts are externally connected to a "tickler" coil coupled to the tuner. These binding posts are added to the detector baseboard B in line with the "input" binding posts Nos. 1 and 2 (see Fig. 1). They are 7/32 of an inch from the edge of the baseboard, and the four binding posts are arranged in such a manner that

they are equally spaced, 1 1/2 inches between centers. Referring to Fig. 1, the wire which leads from the terminal P of the electron tube socket is cut at some convenient place Q and the two ends thus formed connected to the extra binding posts. The method followed in making these connections does, of course, correspond with the style of wiring used in the complete electron tube detector unit. The connection X, from one terminal of the condenser C′, is also removed and a longer wire connected from this terminal to the other side of the point Q where the wire was cut. The base is arranged so that the three remaining sides and a hinged cover may be added without changing the relative positions of the binding posts. Under each of the four corners of the base B, rubber or wood feet (risers) are fastened in order that the binding post heads and wiring will be protected on the under side of the base.

Upright Panel, (A Figs. 1 and 4).—The panel A is any kind of wood about 4 1/2 inches by 5 inches by 3/8 inch thick. In Fig. 4 a back view of the panel is shown which brings the two holes for the telephone receiver binding posts in the lower left-hand corner. If the panel is viewed from the front these two holes will be at the lower right-hand corner. It seems quite desirable that this board present a good appearance, it being the front panel. Four holes are drilled in the panel A, one for the bolt which fastens the panel to the brace, (See L, Fig. 1) two for the telephone receiver binding posts L and M (Figs. 1 and 7) and one for the shaft of the filament rheostat R′ (See Fig. 1.)

The exact location of the hole for the rheostat shaft is determined from the rheostat itself. It is drilled so that the rheostat will occupy as low a position as possible, allowing room enough to do the necessary wiring.

Electron Tube (E, Fig. 7).—The electron detector tube is a commercially available type. The several parts of an electron tube (sometimes called a vacuum tube) are sufficiently described in "The Principles Underlying Radio Communication."

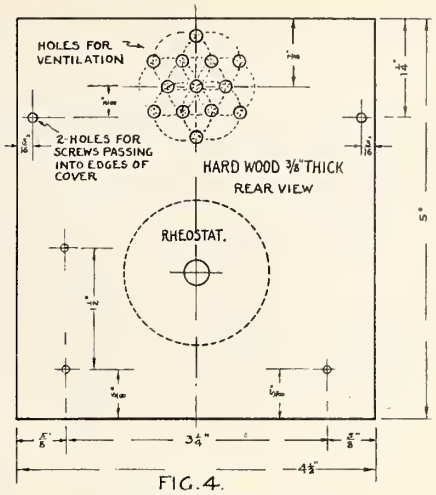


FIG. 4.
A-UPRIGHT PANEL

2-BOARDS FOR SIDES 7¼"×5"×½"
1-BOARD FOR BACK 5"×3¾"×½"
1-BOARD FOR TOP 7¾"×5¼"×½"
2-HINGES, BUTT ¾"

Electron Tube Socket. (S, Figs. 1, 2 and 7).—The electron tube socket is of commercial design. No suggestions are offered as to the particular kind of socket to use. There are many types available and the majority of them will be found satisfactory for this purpose.

Grid Leak and Grid Condenser (R and C, Figs. 1, 2 and 7).—The grid leak and grid condenser may be purchased together or separately or they may be constructed. If one expects to use a detector type of electron tube (sometimes called "soft" or "gas" tube) it is recommended that these two parts be purchased with the tube, care being taken to select the proper values of resistance and capacity for the grid leak and the grid condenser, as specified by the manufacturer of the tube purchased. The resistance of the grid leak will usually be between 1 and 5 megohms (1,000,000 and 5,000,000 ohms) and the capacity of the grid condenser will be about 0.0003 of a microfarad (300 micromicrofarads). If an amplifier type of electron tube (sometimes called a "hard" tube) is used, the resistance of the grid leak may generally be anywhere within the resistance limits specified above and the same size of grid condenser used as mentioned above. Experimental grid leaks may be made for such electron tube detectors. This is only suggested for its educational feature. If the two-stage audio-frequency amplifier is used also, it will be quite difficult to make a grid leak that will work satisfactorily. Such an experimental grid leak may be made from a piece of fiber about 3/8 inch wide, 1 1/2 inches long and from 1/32 to 1/8

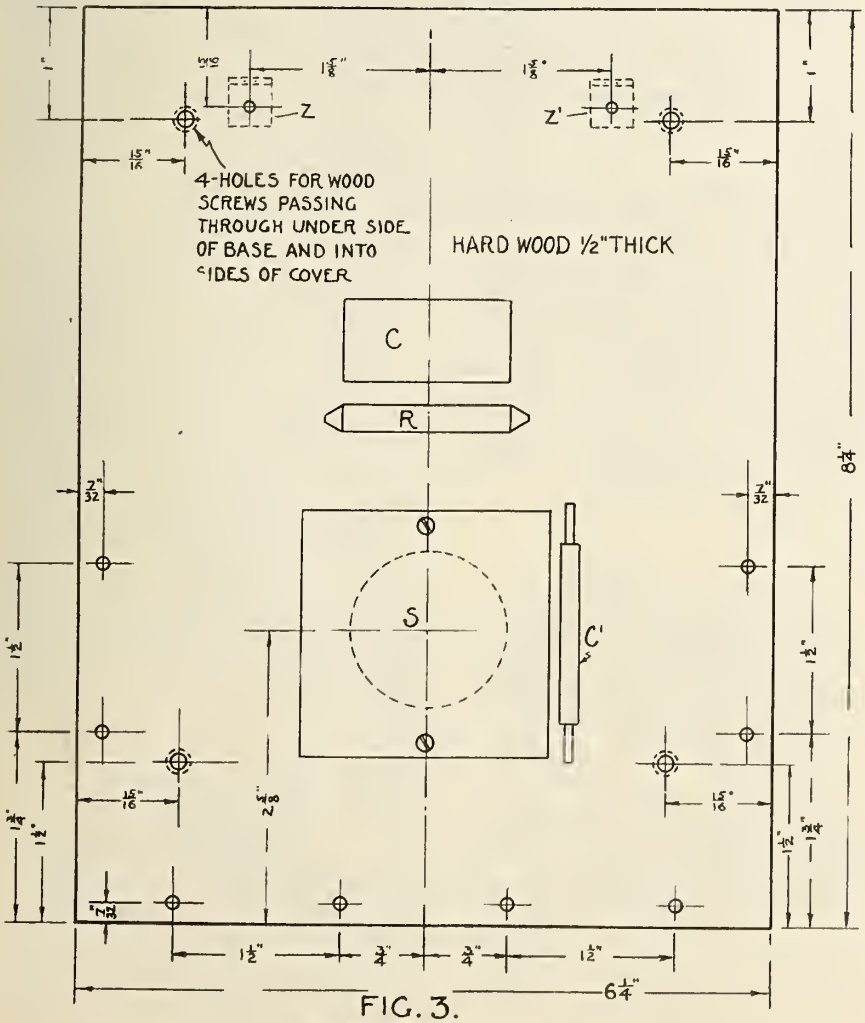


FIG. 3.
B-BASEBOARD.

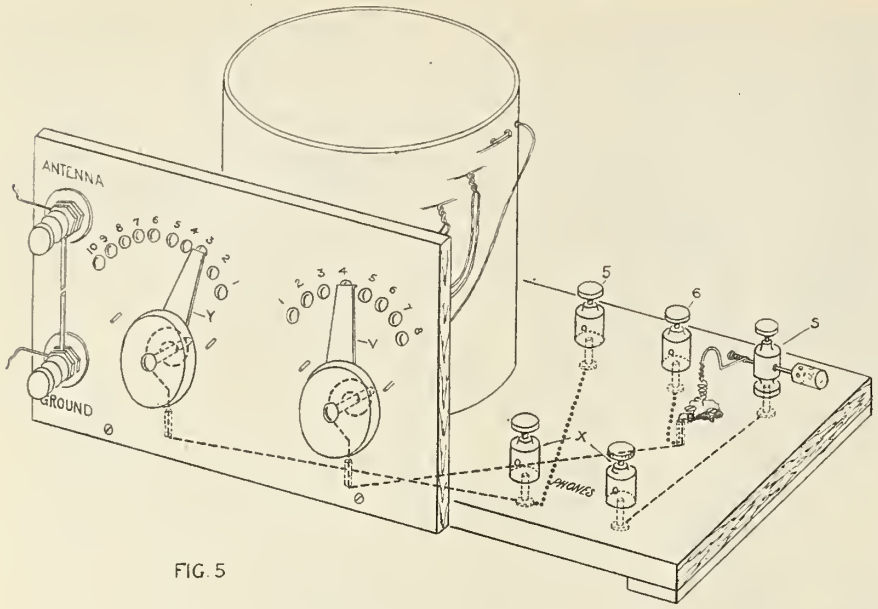


FIG. 5

inch thick. Two 1/8-inch holes are drilled along the center line of the piece, about 1 inch apart. A line is drawn between the two holes, using india or drawing ink. Contack with the ink line may be made by the use of two brass (6-32 or 8-32) machine screws about 1/2 inch long and each equipped with one nut and two washers. The machine screws are put through the holes in the ends of the fiber strip with one washer on each side of the fiber strip. A small piece of tinfoil may be rolled up and wound around each machine screw between the fiber and the washer so that the tin-foil pad will make contact with the ink line. When the nuts are tightened down, the tin-foil pads will flatten out and form a contact between the brass washers and the ends of the ink line. Since the ink line makes a partial electrical conductor of high resistance, the thickness and width of the ink line will determine the resistance of the grid leak to a great extent. The value of resistance may be decreased by inking the line over several times, until the electron tube detector works best. A suitable condenser may be made from tin-foil and paraffined paper after the manner described in Bureau of Standards Letter Circular No. 46, the shape of the condenser being modified to suit the present space requirements, and the total area of each of the tin-foil sheets reduced to six square inches.

By-Pass Condenser (C′ Figs. 1, 2 and 7).—This is any small-sized fixed condenser having a capacity of from 0.0003 to 0.0015 of a microfarad (300 to 1500 micromicrofarads) which may be purchased or made according to the description given in Bureau of Standards Letter Circular No. 46. While this condenser is not absolutely necessary, its use is advisable.

Binding Posts (Figs. 1 and 2).—The binding posts used on the base may be 6-32 or 8-32 brass machine screws each equipped with two nuts and two washers, if regular binding posts are not available. The telephone receiver binding posts L and M, (Figs. 1 and 7) should be of the set-screw type to admit the tips of the telephone receiver cords.

Filament Rheostat (R′ Fig. 1).—As has been previously stated, the filament rheostat may be constructed but no details are furnished. If the rheostat is purchased, it is desirable to select one designed for panel mounting as well as one having a neat appearing knob and pointer. The rheostat should have a resistance of about seven ohms and a current-carrying capacity of about 1 1/2 amperes.

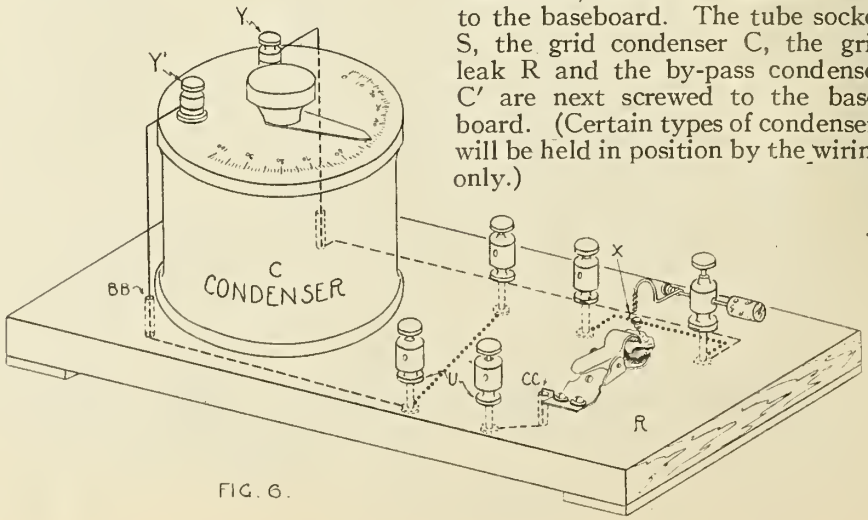


FIG. 6.

Accessories.—The accessory batteries are commercial articles. The purchaser of a storage battery for lighting the filaments should get full instructions from the dealer for testing and re-charging the battery. The dry battery ("B" battery) usually used for the plate circuit can not be re-charged. The normal life of a battery of reliable manufacture is about six months. Storage batteries for use as "B" batteries are available. Their first cost is greater than that of dry batteries but they may be re-charged.

Assembling and Wiring

Wood Finish.—It is essential in electron tube sets that the wood be protected from moisture. While the wood base and panel may be treated with paraffin as suggested in Circular No. 120, it was found more satisfactory to first dry the wood and then stain and varnish it, using a good varnish, preferably insulating varnish. Shellac is not recommended. It is rather difficult to give definite suggestions concerning drying and staining of wood. Wood may be put in a warm oven for an hour or so to insure more or less complete drying. A lamp-black or carbon pigment stain is not used ordinarily on such radio parts and it would be well to avoid the use of such. The stain and varnish are thoroughly dried before the apparatus is mounted on the wood baseboard and panel.

Baseboard (B, Figs. 1 and 7).—The eight brass machine screws or binding posts are put in the holes already drilled in the baseboard. If machine screws were to be used the heads would be put on the under side of the baseboard with a brass washer between the head and the baseboard. A brass washer and two nuts are then fastened to each screw, on the upper side of the baseboard, with the washer next to the baseboard. The tube socket S, the grid condenser C, the grid leak R and the by-pass condenser C′ are next screwed to the baseboard. (Certain types of condensers will be held in position by the wiring only.)

The exact location of these parts can not be stated because the several types of parts commercially available will vary somewhat in dimensions. One can get a very good idea of the relative positions of the several parts from Figs. 1, 2 and 7. The tube socket S is mounted so that the two terminals marked G and P (Fig. 1) are nearest the upright panel. Blocks Y and Y′ are put under the socket S so that the four terminals of the socket do not touch the wood baseboard. This is done by cutting solidly and pulling on the other end just hard enough to stretch the wire slightly. It is also a good plan in wiring such sets to have all wires run as directly as possible, neatly, and all bends made at right angles. When a wire is attached to a binding post, a loop or eye is formed on the end of the wire and the wire at the eye flattened with a hammer. This gives more contact surface. Special lugs may also be soldered to the ends of the wire before the connection is made. A small hole is drilled through the baseboard are shown by dotted lines. A short piece of wire is soldered to the wire leading from the right-hand socket terminal marked F, just above the baseboard and led to the "input" binding post No. 1, and fastened between the washer and the first nut.

This wire is shown as a solid line which means it is on the upper side of the baseboard. The wires do not touch the wood boards except at the terminals and where the wires pass through holes in the baseboard. The wires may be

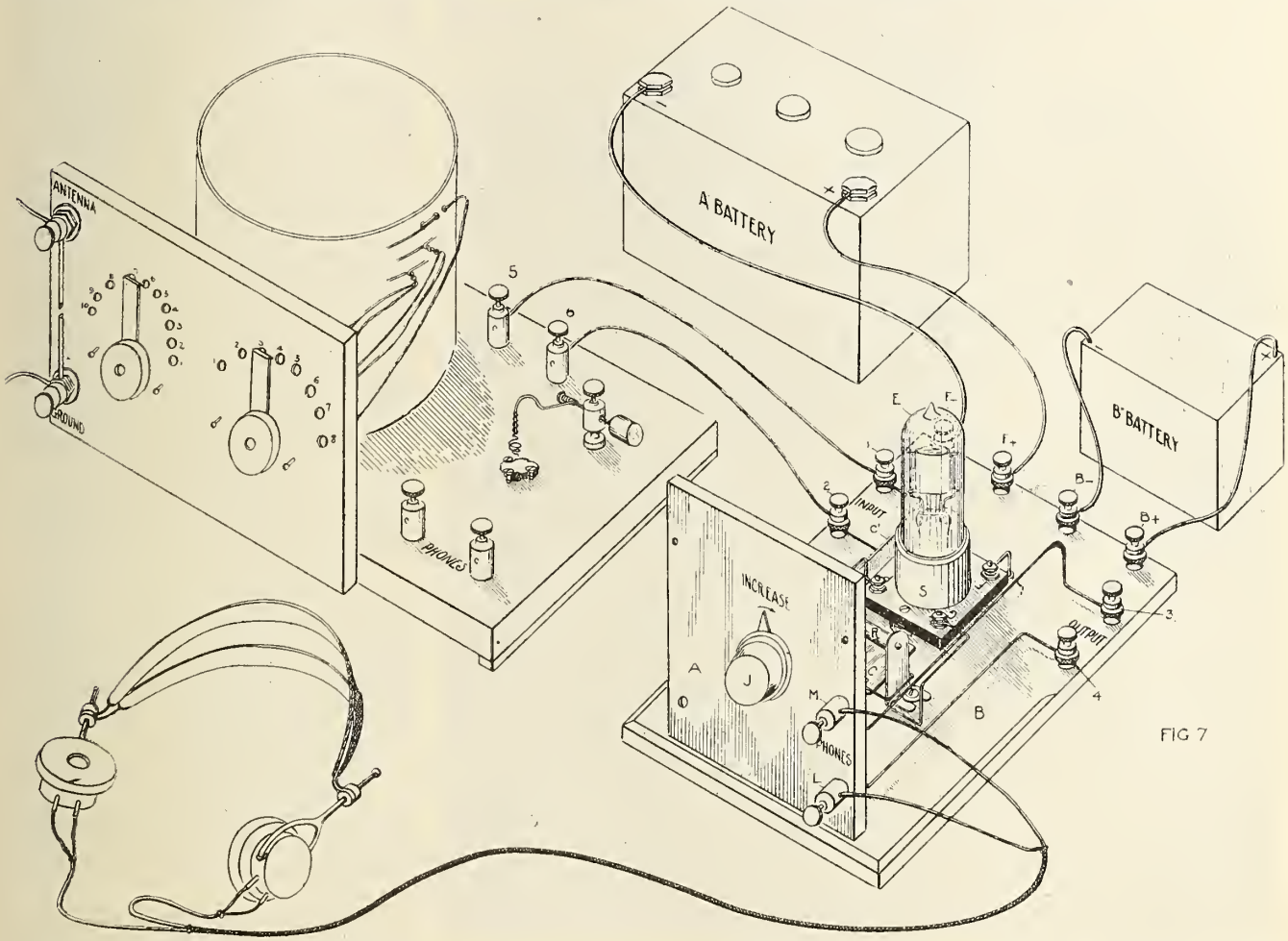


FIG 7

off two round wood blocks just long enough to raise the socket terminals clear of the base, and mounting them so that the screws which hold the socket to the baseboard will pass through holes in the centers of the blocks. After the socket, S, grid condenser C, grid leak R and by-pass condenser C′ are mounted the parts are wired up.

Number 14 bare tinned copper wire is used in wiring. This makes the connections stiff and self-supporting. This wire is ordinarily furnished in rolls. The wire should be straightened before it is used. It can be straightened by clamping or otherwise fastening one end baseboard just back of each of the tube socket terminals marked F (See Fig. 1). A short piece of wire is fastened to the right-hand socket terminal marked F and is then led through the small hole in the baseboard to the under side of the baseboard.

The same wire is led to the binding post F and fastened between the machine screw head and washer underneath the baseboard. The same wire is further led to the binding post marked B.... and fastened between the machine screw head and washer underneath the baseboard. All wires which are run on the under-side of the base- raised more or less to accomplish this. The two terminals of the grid condenser C are connected to the two terminals of the grid leak R as shown in Fig. 1. A wire is soldered at V and led to the input binding post No. 2. This wire is kept quite close to the baseboard. Another wire is soldered at V′ and led to the tube socket terminal marked G. The remainder of the wiring is left until the upright panel is assembled and fastened to the baseboard. Notes on soldering are given later.

Upright Panel (A Figs 1, 2 and 7).—The filament rheostat R′ is mounted on the upright panel A

so that the two terminals will be in a convenient position for wiring. Two binding posts of set-screw type, L and M, (Figs. 1 and 7). are inserted in their proper holes, and the upright panel mounted in position by bolting it to the two brass angle pieces (Z and Z′) shown in Figs. 1, 2 and 3. One of the telephone receiver binding posts L serves as a bolt. Two small holes are drilled through the baseboard near the two terminals of the filament rheostat R′. A wire is run from the "output" binding post marked 4 (Fig. 1) along the upper side of the baseboard to the back of the telephone receiver binding post marked L. A wire is fastened to the tube socket binding post marked P and from thence led to the back of the telephone receiver binding post marked L, or else soldered to a convenient place on the wire leading from binding post L. These wires are shown in Fig. 1. A wire is run from the binding post marked 3 to the back of the telephone receiver binding post marked M and also a wire from B× to binding post No. 3, underneath the baseboard. One of the terminals of the by-pass condenser C′ is connected at the point X and the other terminal of the condenser is connected at the point X′. The method of making these connections depends to some extent on the particular type of fixed condenser which is used. If the condenser be provided with flexible leads one of them is soldered at the point X and the other is likewise connected at the point X′. If the condenser is provided with lugs, connections are made by bending the wires into the proper shape and soldering thereto. A wire is run from the filament rheostat binding post marked T through the hole in the baseboard and thence along the under-side of the baseboard to the binding post marked F−. This wire is shown in Fig. 1 by a dotted line. Likewise a wire is run from the rheostat binding post W underneath the baseboard and up through the left-hand hole in the baseboard at the rear of the electron tube socket S and connected to the left-hand binding post marked F. This completes the assembling and wiring of the electron tube detector unit.

Directions for Operating

Connections.—It has already been stated that better results are obtained if the two-circuit tuner described in Bureau of Standards Circular No. 121 is used with the electron tube detector. However, the single-circuit tuner described in Circular No. 120 may be used or the electron tube detector may be connected to any tuner not already supplied with an electron tube detector.

If the single-circuit tuner is used with this electron tube detector the several parts are arranged somewhat as shown in Fig. 7. The single-circuit tuner (shown at extreme left) is fully described in Circular No. 120. Two more binding posts are added in the back right-hand corner and wired as shown in Fig. 5. The greater portion of the wiring is beneath the baseboard. The wires shown as - - - - are those already described in Circular No. 120. The wires shown as . . . . . are the new wires added. Such wiring will not disturb the set for use as a crystal detector receiving set. The second unit to the right is the electron tube detector described in this circular. Accessory parts such as telephone receivers, "B" battery and "A" storage battery are also shown in Fig. 7. As previously mentioned, the "A" battery is shown here reduced in size, and it is usually placed under the table upon which the rest of the apparatus is mounted.

If the two-circuit tuner is used with this electron tube detector the arrangement of the parts is similar to that shown in Fig. 7, except that the two units consisting of the coupler, and the variable condenser with crystal detector, replace the single-circuit receiving set shown at the left. Connections between the secondary of the coupler and the terminals of the variable condenser are the same as described in Circular No. 121. Two more binding posts are added at the rear edge of the baseboard supporting the variable condenser and crystal detector (see Fig. 6.) The dotted lines clearly indicate the new wiring connections as described for the single-circuit receiving set.

The antenna and ground wires are connected as described in Circular No. 120 and as shown in Fig. 7. Binding post No. 5 (Fig. 7) is connected to binding post No. 1 and binding post No. 6, is connected to binding post No. 2. The telephone receivers are connected to the binding posts L and M as shown in Fig. 7. The red (positive,+) wire of the "B" battery is attached to the electron tube detector binding post marked B+ and the black (negative,−) wire to the binding post marked B−. An insulated flexible copper wire is run from the red (positive,+) terminal of the 6-volt "A" storage battery to binding post marked F+ (Fig. 7) and a similar wire from the black (negative,−) terminal of the "A" battery to the binding post marked F−.

Operation.—The filament rheostat knob J (Fig. 7) is turned to the extreme left and the electron tube E inserted in the electron tube socket S. The filament rheostat knob is then turned to the right until the electron tube filament becomes lighted, the brilliancy depending upon the type of electron tube used. When one of the telephone receiver terminals is removed from its binding post and again touched to the post, a sharp "click" in the telephone receivers will be an approximate indication that the circuit is in working condition. If the test buzzer as described in Circular No. 120 is available, it may be attached (as described) to the tuner binding post marked ground" and then the rheostat adjusted until the sound in the telephone receivers is the loudest. The reader should bear in mind that the electron tube detector unit is merely substituted for the crystal detector and the tuning of the receiving circuit is the same as described in Circulars Nos. 120 or 121. When signals from a desired transmitting station are heard as loud as possible by tuning, the intensity may sometimes be improved by adjusting the knob on the filament rheostat so as to increase or decrease the filament current (current from the "A" battery). The knob is kept in the position of minimum filament current without reducing the strength of the incoming signals.

If a detector type of electron tube be used, the voltage of the "B" battery is changed until the greatest signal intensity is obtained. This necessitates the use of a tapped "B" battery.

The operator must not expect too much of the apparatus at the first trial, and even assuming that he has had experience with crystal detectors, some difficulty may be experienced in getting the electron tube to operate. In this case he should first ascertain if the various parts of the complete receiving equipment are properly connected; or again, it may be found that some of the connections to the electron tube detector unit are improperly made. Special care should be taken to see that the "A" and "B" batteries are connected to the proper terminals of the electron tube detector unit. After a little experience the operator will find the electron

(Continued on page 18.)

World's Greatest Electrical Station Has Its Own Radio School

It Revolutionized Broadcasting Programs and Was the Pioneer in Wired Wireless

THE Commonwealth Edison company, as befitting the largest central station electric company in the world, conducting the world's largest electrical appliance store, has been a potent factor in the progress and expansion of the latest marvel of electrical development—radio.

The recent pioneer experiments, made by E. W. Grover, and E. H. Gager, Edison engineers, under the direction of Ernest F. Smith, Superintendent of Sub-Stations, in so-called "wired wireless" (an account of which is given in later paragraphs) have attracted wide editorial attention and provoked much comment among radio experts throughout the country

But aside from the purely commercial aspects, the Edison company has been particularly concerned with the broad, constructive side of radio expansion and development; in promoting the educational and entertainment features, which have come to be used for the benefit of the general public.

One of the outstanding results of the Edison company's policy in this respect, is the broadcasting of grand opera during the winter months from station KYW, one of the finest radiophone broadcasting outfits in the country, which is operated by the Westinghouse Electric and Manufacturing Company, from the roof of the Edison building, 72 West Adams street, Chicago. This was the first radiophone station in history to broadcast grand opera, and the only radiophone station to ever broadcast the complete programs of an entire operatic season, as it did here, last year

Because all radio fans appreciate good music, and the radio receiving set, as the most up-to-date and novel means of having it in the home, the inside story of how opera broadcasting was launched by the Commonwealth Edison Company will be of interest here.

A little more than a year ago, George B. Foster, Assistant to Vice-President John F. Gilchrist, of the Edison company, an early radio enthusiast, installed a receiving set in his home, and, as he

(Continued on page 10.)

M. R. Brennan, Superintendent of New York City Police Telegraph, operating the new radio broadcasting station of the New York Police Department, known as W L A W. It will not be long before the radio transmitter will enjoy the position of being the criminal's greatest peril.

Sad News for the Crooks

THE first radio broadcasting telephone station to be exclusively for police purposes is installed at the New York headquarters. After a test, Joseph A. Faurot, deputy commissioner, estimated that an area of at least 30,000 square miles could be covered with it.

"This should prove a great aid," said Faurot, "in finding stolen automobiles and missing persons, in spreading alarms and in other work where secrecy is not essential. Every amateur receiving station within a radius of 100 miles will become a sort of police outpost, enabling us to spread emergency information quickly.

"Later, as our men gain experience, we may even use the ether to spread confidential reports by special code."

Secretary of Commerce Hoover has given permission to Commis-

(Continued on page 18.)

(Continued from page 9.)

afterwards put it, "was engrossed for a while but soon became bored with hearing some one yell in stentorian tones, 'one, two, three, four—I am testing—one, two, three, etc.' This was followed by a bevy of amateur wireless telegraph operators dashing out the Morse, A B C, and other 'uncharted' codes, of their own invention, with palsied hands. One night, however, Mr. Foster was thrilled at picking up the music of a phonograph. He quickly summoned his wife, who listened a few moments without much enthusiasm.

"We've got the same record for our own phonograph," said Mrs. Foster, "which is closer at hand."

"Well, my dear," answered Mr. Foster, "I expect I'll have to get grand opera for you." He spoke jokingly, but the crux of the idea was there; the vision of sending the voices of the world's greatest singers from the stage of the Auditorium Theater in Chicago to the radio fans within a radius of 1,000 miles or more, by means of a huge broadcasting station. This was the beginning of the idea, which proved the outstanding event in the radio world during the period of last year.

Imbued with the possibilities for educational work, and the entertainment features which could be obtained from a huge radiophone transmitting station, Mr. Foster and other officials of the Edison company set about to erect the basic foundation of their vision and accordingly negotiated with the old Chicago Opera Association (which has since become the Chicago Civic Opera Company, with Samuel Insull, as president) for the broadcasting of opera nightly during the 1921-22 season.

The next step necessary in the fulfillment of the plans of the Edison Company, was a powerful transmitting station. Negotiations were opened with several prominent radio apparatus manufacturers, which eventually resulted in the plan of the Westinghouse Electric and Manufacturing Company to operate Chicago's famous radiophone station. (Incidentally, the Westinghouse organization stands out as one of the real pioneers in radio development as Harry Phillips Davis, Vice President of the company, is known as the "father of broadcasting," and is credited with being the first to see the popular appeal of radio.)

Thus, it came about that the Edison company erected the towers, which now rise 125 feet from the roof of its general office building (and 400 feet from the street level) and set aside space in its general office building for the radio studio and station, which the Westinghouse company had arranged to install and operate.

From start to finish, the whole scheme of opera broadcasting was one of splendid cooperation from all concerned—the opera company and its artists and musicians, the Westinghouse company, and its officials and engineers, the Illinois Bell Telephone Company, and the Chicago newspapers.

The final steps for the completion of the plan came early in November of last year, when the Westinghouse organization installed the microphones in the footlights of the Auditorium stage, and the Illinois Bell Telephone company ran wires from the theater to the radiophone station, where the voices of the singers were amplified and broadcasted and received by surprised radio fans in thousands and thousands of homes in the Middle West.

The formal announcement of the history-making event and the first grand opera sent over the radiophone took place on Armistice Day, November 11, of last year. Miss Mary Garden, then director of the old Chicago Opera Association, made the dedication address, announcing the innovation to the radio world. Miss Edith Mason, prima donna, sang the aria from "Madame Butterfly," and the instrumental numbers were given by the Chicago Opera orchestra, under the direction of Giorgio Palacco, now First Conductor and Musical Director of the Chicago Civic Opera Company. The same day, telephone calls flooded the offices of the chicago newspapers, and for the next few days letters and telegrams from such distant points as Georgia, Florida, Texas, and Maine were received by the opera company officials and the Edison company telling of the surprising clearness of the singer's voice and the notes of the musicians.

On the technical and commercial sides, the Commonwealth Edison Company has enjoyed a unique position, in the realm of radio. The Edison company, it is believed, was the first central station electric company to successfully demonstrate the feasibility of speech transmission over underground electric cables, without interfering with their normal function (of supplying customers with light and power.) The pioneer tests made by Edison engineers, under the direction of Superintendent of Sub-Stations Smith—without going into a highly technical explanation—have shown that it is possible to talk from one central station to another, or from one sub-station to another, by means of the "wired-wireless," using the underground cable systems for carrying high frequency currents.

Using a radio telephone set, designed by Mr. Gager, the output of which was coupled to the high tension bus, instead of to an antenna, speech was transmitted a distance of several miles over an underground cable carrying 12,000 volts, in the Edison company's system, which was "alive" and carrying "load" at the time, and which was connected to approximately 375 miles of similar cable. The low voltage (110-220 volt) direct current system of the Edison company consists of about 230

(Continued on page 12.)

Do Your Employes Really Know Radio?

HERE is an up-and-coming article about what the world's largest electrical appliance store has done and is doing for the promotion of its own business and for the extension of radio service generally.

This great store has its own electrical institute with a twenty-lesson course for the company's rank and file!

This company first introduced grand opera as a broadcasting feature, there-by setting the country afire with interest in home radio.

This article tells about the men who first sent spoken messages over underground electric light service cables, astonishing the electrical world with the first "wired wireless!"

Read the story and get an inspiration out of it, just as we did.—The Editor.

How to Make an Audio Frequency Amplifying Transformer

By F. D. PEARNE
Chief Instructor in Electricity at Lane Technical High School and Technical Editor of Radio Age

MANY amateurs are not aware of the fact that an amplifying transformer is a comparatively easy thing to make, if one is mechanically or electrically inclined. The following instructions, if carefully adhered to, will produce a transformer designed to do all and more than some of the amplifying transformers now on the market. It may not be so handsome as some, but it will be found to produce good results.

The core is constructed of silicon sheet steel, .018 of an inch in thickness, or, if this cannot be procured, electrical sheet-iron of the same thickness may be used. Enough pieces or the shape and size shown in Figure 1 to make a stack one-half inch high, when pressed tightly together, should first be cut from the sheet. Four extra pieces of the same size and shape should also be cut out, to be used in finishing out the core when it is assembled. These can be partly cut out with a pair of tinners' shears and the balance cut out with a sharp cold-chisel.

When these are finished cut out enough of the pieces shown in Figure 2 to stack up one-fourth inch high and the same number of pieces shown in Figure 3 should also be made. Next, cut out the pieces shown in Figure 4. Enough of these to make a stack one-half inch high will be required. This completes the cutting of the steel or iron.

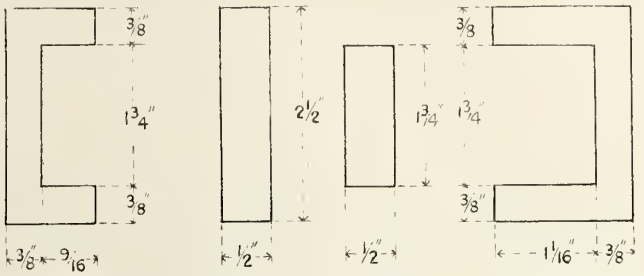


FIGURE 1

FIGURE 2

FIGURE 3 FIGURE 4

FIGURE 5

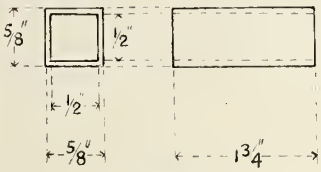


FIGURE 6

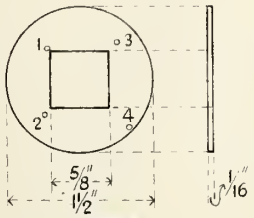


FIGURE 7

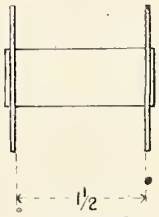


FIGURE 8

A paper tube is next constructed as shown in Figure 6. This consists of a strip of good, heavy paper one and three-fourths inches wide and about seven inches long, covered on one side with shellac varnish. Before the varnish becomes dry, wind it up into the form of a tube, on a piece of square metal rod one-half inch square, or on a square block of wood of the same size. Be sure that none of the shellac gets onto the rod, as this would cause the tube to stick to it, making it impossible to remove the form after the shellac becomes hard. When the paper is all wound on, it should make a tube one-sixteenth of an inch thick. The outside should be five-eighths of an inch square.

Now procure a piece of sheet-fiber one-sixteenth of an inch thick and cut out the two coil ends as shown in Figure 7. Four holes are drilled in one of the coil ends as shown. Hole Number 1 is drilled as close to one corner of the square as possible without breaking through. Hole Number 2 is drilled one-fourth of the distance out from the next corner. Number 3 is also one-fourth of the distance out from the next corner as shown, and hole Number 4 is drilled as close to the outside edge as possible, without breaking through. These holes are drilled in one end only, as all the terminals of the coils are to come out one end.

After the ends are completed, they are forced on the ends of the tube to the position shown in Figure 8. Be sure that these ends are put on nice and straight and that the distance between them is one and one-half inches as shown on the drawing. When this is done, the spool is ready for winding. Because of the small winding space and the fact that it is impossible to do layer winding with wire of the

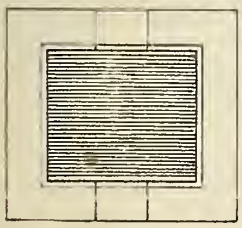


FIGURE 9

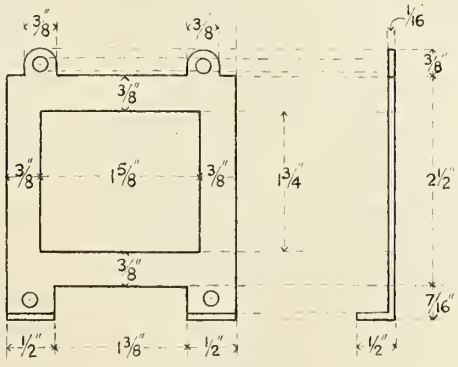


FIGURE 10

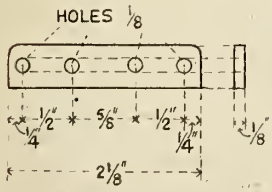


FIGURE 11

FIGURE 12

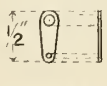


FIGURE 13

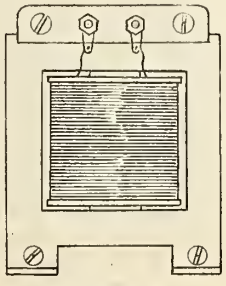


FIGURE 14

size used, it is necessary to use No. 39 enamel insulated copper wire. The winding can be done better in a lathe, if no winding machine is available, but some means for counting the number of turns put on must be supplied. The spool can be slipped onto the original block or rod upon which the tube was made and the end held in the chuck of the lathe, with the end of the spool in which the holes were drilled to the left. Put about six inches of the wire through hole Number 1, to be used for connecting, and begin to wind. The wire should be kept nice and even and should be wound as nearly as possible in layers.

Wind 4,000 turns and then break the wire, putting the end through hole Number 2, which will complete the primary winding. Fit one or two layers of paper over this coil and start to wind the secondary. Lead an end out through hole Number 3 for terminal connection, and wind 16,000 turns in the same direction as the other coil. This should just fill the spool and the final end is brought out through hole Number 4. Now cover the outside of the coil with two or three layers of paper, for protection, and then fit a piece of black binders' cloth neatly between the ends to make the final covering.

The core is now assembled. Figure 5 shows how the pieces of iron are alternated and placed inside the tube. First insert one of the pieces, Figure 2, and then one of Figure 3, etc., until as many pieces as can possibly be squeezed in are in place. The two outside pieces should be those shown in Figure 2.

The outside core is assembled next. First, take one of the pieces shown in Figure 4, and slip the two ends between the bottom piece of the core and the next one to it. Then put another piece, Figure 4, in place on the other side of the coil, slipping the ends between the two pieces of the core, which are next in order for those used for the piece on the other side. Now, put in one of the pieces shown in Figure 1. This will not go between the pieces of the core, but will come up squarely against the core iron. Put another piece of Figure 1 on the other side in the same way, and follow this with another long one on the other side in the same way, and follow this with another long one on the other side, which will go between the next two pieces of the core. Continue in this way until the entire outside shell is completed. It will be necessary to fill out the side irons with extra pieces of Figure 1,

(Continued on page 30.)

Send in Calls Heard

NOW that cooler weather is luring the radio fans back to their receiving outfits the old rivalry as to who hears signals from the most distant transmitting stations has flamed up again. We have some letters telling of some remarkably long distance signals received.

Why not find out what your neighbor is doing in the way of long distance receiving?

Beginning with the next issue RADIO AGE will publish a department called "Pick-Up Records". Under that title we will publish each month the lists of calls heard by readers. This is not only a valuable feature for radio fans on the receiving end but it tells transmitters how successfully they have been operating.

Send in your lists, giving call numbers of stations heard and location and distance.

Biggest Radio Store Has Its Own School

(Continued from page 10.)

miles of underground cable, with the heaviest network, of course, in the "Loop" district. Using the same set, speech was transmitted through the heaviest part of the net work, reception (of the voice) being accomplished with only a detector tube connected with a lamp socket, no amplification being used.

Of course this method is still in an experimental stage, and there are many engineering problems still to be solved, but the tests indicate that the underground cables of the Edison company and other central station companies can, perhaps, some day be utilized in broadcasting news and musical programs.

General George O. Squier, Chief Signal Officer of the United States Army, was quoted recently, in commenting on the Chicago tests, as stating that the public has become accustomed to look to the electric socket for every domestic convenience and may some day come to look there for news and entertainment as well.

At present, reception of space broadcasting—by radiophone—has the objection that antennae in some form is required, engineers say. Difficulties in erecting aerials have already been experienced in some localities and they may be expected to be increased as radio receiving sets are installed promiscuously. With carrier-current broadcasting through the lamp socket, the need for the aerial is eliminated, as only a small condenser properly inserted between the socket and an ordinary receiving set is effective.

The radio section of the Edison electric shops was among the first established, by a central station company, in this part of the country. Although a success financially, it is interesting to recall that this department was launched primarily as a means of stimulating interest and aiding in the development of radio. This department handles every imaginable radio device and like others in the Electric Shop contains a stock that is as complete as any to be found in the country.

Collectively and individually many of the department heads and employes of the Edison company have gone in for the serious study of radio. The Central Station Institute of the company, as early as last December opened a 20-lesson course for the radio enthusiasts in the company's ranks.

This course includes elementary electricity, with special attention to alternating currents; theory of radio, covering oscillating currents, transmitters, receivers, antennae and vacuum tubes practice of radio, covering construction and operation of apparatus used. Lectures were given by the company's engineers and radio experts, several of whom were formerly radio instructors in the United States Army.

The Edison Symphony Orchestra, of which Morgan L. Eastman, is conductor, has been a frequent feature of the KYW musical program. Mr. Eastman, also acts as musical director of the Westinghouse Radiophone station.

Radio Airmen

Illinois now has two training schools for aircraft radiomen, one at the Chanute aviation field at Rantoul and the other at the Great Lakes Training Station. The U. S. naval bureau of aeronautics maintains a flying school and airdome at Pensacola, Florida, and Great Lakes students go there to complete their course. Sixty men were graduated to the new rating during last year at Pensacola. The Rantoul school was moved there from Post Field, Fort Sill, Oklahoma, where the largest observors' and radiomen's school was being maintained in conjunction with airplane and balloon pilots' schools. The course for radiomen aviators covers a period of six months.

Biggest Radio Vacuum Tube in the World and How It Was Made

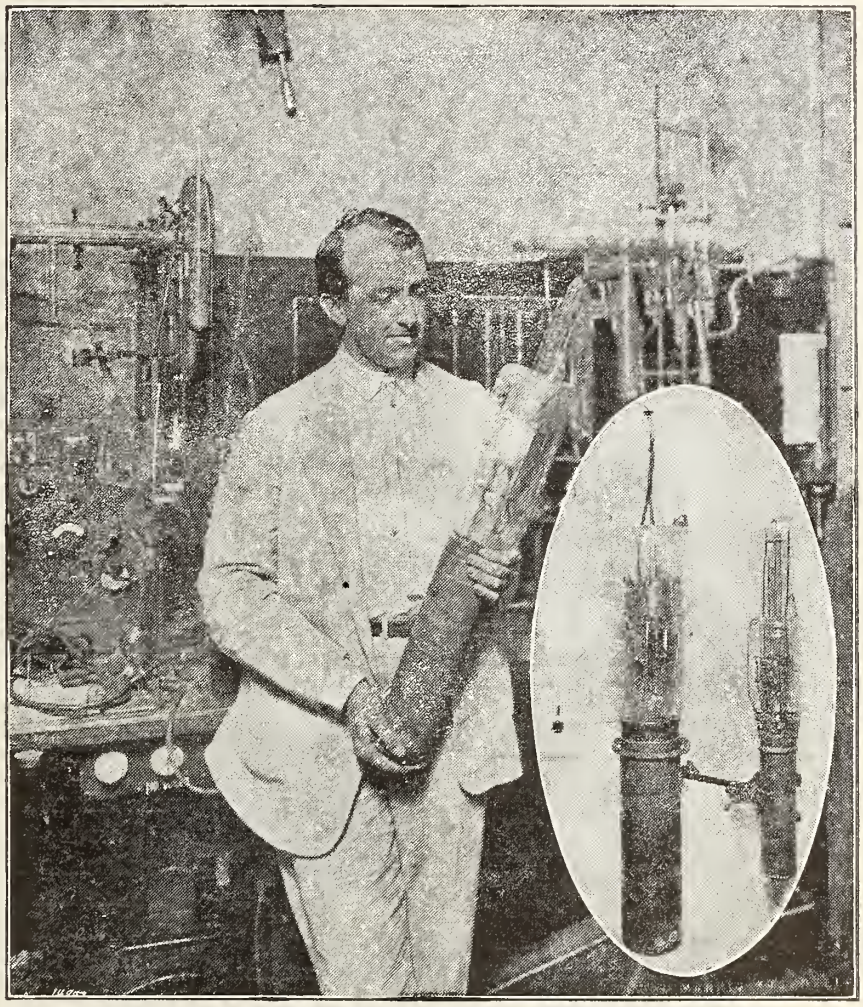
Western Electric Engineers Develop Tube to Handle 100,000 Watts of High Frequency Power.

WHEN engineers of the Bell Telephone System accomplished the first transmissions of speech across the Atlantic in 1915, they used 300 vacuum tubes, not much larger than the ones in your radio set, to generate the necessary high frequency power. Since that time developments have gone on in the Bell System Laboratories of the Western Electric Company in New York, resulting in the manufacture of tubes of the same general type which will supply 250 watts and more. Two of these 250-watt tubes generate the power for the larger broadcasting stations, such as WBAY, WEAF and others. Now the telephone laboratories have developed a tube capable of supplying 100,000 watts, or 200 times the power required for the usual broadcasting station of 100-mile range.

The essential feature of the new tube is that the "plate" is a copper cylinder forming the outer wall of the tube. In the customary tubes used in radio sets, the "plate" is an actual plate or small cylinder of thin metal enclosed in a glass tube. If even a small fraction of an ampere is passed through the plate circuit of one of the small tubes, the plate will become very hot. In the larger "power" tubes this heat becomes so great that some means other than radiation must be provided to carry it off, or the tube will collapse. This is easily done when the plate is the outer wall of the tube, for it can be put into a tank of water which circulates through a radiator. The tube is then water-cooled just like and automobile engine.

This sounds easy enough. The real difficulty was to make the whole tube air-tight and to get the wires for the filament and grid into the tube while keeping them insulated against about 20,000 volts. After much study, the problem was narrowed down to finding a way to make an air-tight joint between the heavy copper tube which forms the "plate" and the glass of the upper part of the tube, and to bring the heavy wires through this glass. Credit for the answer is to due to W. G. Housekeeper, a Western electric engineer, who discovered a way to seal copper to glass which would make an air-tight joint that would not crack at any ordinary working temperature.

One of these big tubes stands three feet high and is 3 1-2 inches in diameter at the bottom. To heat the filament for which in radio receiving tubes a single dry-cell or a small storage battery is enough, this tube used 6,000 watts. For the plate circuit, instead of the familiar "B" battery, a high voltage direct-current generator is used, or an alternating current rectifier.



W. G. Houskeeper, the Western Electric engineer whose epoch making invention led to the production of the world's largest vacuum tube, and the tube itself. Insert shows in graphic fashion just how the new monster tube compares with the little "peanut" tube used in the average radio receiving set and the 10,000 watt tube which only recently was considered the last step in this department of science.

The significance of these big tubes is that only a very few would be necessary to operate even the largest radio stations now in service. The combination of vacuum tube and its current supply, it is expected, will be less costly, more rugged and more easily adapted to various wavelengths than any other source of radio power now in use.

Coats Wins Fame

Paul B. Coats, the Chicago novice who made an efficient super-regenerative receiving set of the Armstrong pattern and installed the remarkably successful unit in his touring car, has won considerable fame from the account of his achievement published in the September issue of Radio Age. The Radio Club of Illinois held its first meeting of the season the other day and Mr. Coats gave a demonstration of the circuit.

Wisconsin U Resumes

The University of Wisconsin station, W H A, at Madison resumed operations on October 2, after six weeks of silence. Improvements have been made in the plant. The regular noonday broadcasts are resumed. They comprise weather forecasts and educational lectures. Educational and musical programs will be broadcast on Tuesday and Friday evenings.

Minneapolis in Line

The city of Minneapolis is to have a high-powered radio telephone transmitting station capable of reaching into the farthest stretches of the Northwest. The cost of this station for the first year will be borne by business men of Minneapolis who feel that in the new science of radio telephony they have a weapon, which, if properly used, can be a powerful influence for Minneapolis' welfare.

P. J. Carr Campaigns by Radio

First in Chicago to use the Radio broadcaster as a means of reaching the people is P. J. Carr, Treasurer of Cook County, who is a candidate on the democratic ticket to succeed himself.
The other evening Mr. Carr spoke through the instrument at station W D A P in the Drake Hotel.
This is what he said:

STATION W D A P—P. J. CARR, TREASURER OF COOK COUNTY, ILLINOIS, SPEAKING:

Folks, perhaps you would like to hear a word or two about the organization which collects Cook County's taxes.

The County Treasurer has nothing at all to do with establishing the amount of taxes nor has he anything to do with spending them. His task merely is to collect the money and later to apportion it to the organizations entitled to it. However, between the time he makes collections and the time he makes disbursements he has large sums in his custody. It is the County Treasurer's business so to administer these funds that the people shall derive the greatest possible benefit and I am glad to say that from April, 1921, when I was appointed County Treasurer, until the present I have obtained from these funds an interest total of $654,419.90 or $100,000 more than that produced by anyone of my predecessors in the history of Cook County.

In this way, during an era of unparalleled public extravagance, I have tried to lighten the tax payer's heavy burden.

Tax paying is not the most agreeable job in the world but I am endeavoring to make it easier for the citizens of Cook County. I have established 100 substations throughout the county and I now contemplate a system by which every tax payer may pay his taxes at a convenient sub-station, located in banks, drug stores and other suitable places, so that he may have the same facilities that are now accorded those who pay gas and electric light bills. However, for this service there will be no extra charge of any kind. This system, which I believe is feasible, will do away with every possible inconvenience occasioned by present methods.

There are a number of other things we are trying to do for the public. We have a corps of experts who, without any charge whatsoever give advice to those in trouble with tax sharks. There is a foreign language bureau where tax payers who have difficulty with American speech may transact their business in the mother tongue.

I have also caused to be established a department in charge of a competent real estate expert where all requests for tax bills may be presented and receive immediate attention.

This department has earned the approval of thousands of taxpayers and has been commended especially by all real estate agents, bankers and brokers as they are assured of receiving their tax bills in ample time to avoid penalties.

To better the efficiency of my office, I have devoted my time and energy to its duties and I have demanded from all of my employes that business-like, efficient and decorous treatment be accorded to everyone who has occasion to come in contact with us. From the many commendations, both verbal and by letter, which I have received, I believe that I have been fairly successful.

In conclusion, I take advantage of this opportunity to invite you who are residents of Cook County to send to my office any suggestions in reference to the tax matters which I have tried to discuss in this limited time. Indeed I shall be glad to have any of you call upon me to discuss these tax problems so important to all the tax payers of Cook County.

I thank you.

WDAP Becomes a Station De Luxe

By EDWARD L. TAYLOR

RADIO broadcasting has taken a great step forward in Chicago through the establishment of the super-station located in the Drake Hotel. Fans everywhere will be interested in the Midwest Radio Central, for its equipment is powerful enough to keep it in communication with both the Pacific and the Atlantic coasts. Its call number will be WDAP, which was the number assigned to the station when it was in the Wrigley Building tower. However, it is a far more powerful plant than when it was perched above the Chicago River at Michigan boulevard.

Radio fans everywhere will be interested doubly in the prospective opening of this great station when they learn that one of the prime features of the service to be rendered from WDAP will be the excellence of its programs. The owners announce that they will transmit vocal and instrumental gems sung or played into the microphones by the highest class artists available in the country.

Those who have listened to WDAP for the last few months have been impressed with the quality of the entertainment provided. Many of them know that the two men back of the interesting service rendered from the Wrigley tower and now the promoters of the de luxe station on the Drake roof, are Thorne Donnelley and J. Elliott Jenkins, Chicago pioneers in radio.

The studio of Midwest Radio Central is located on the eleventh floor of the Drake. Two features distinguish this studio: Its luxurious appointments and its elaborate arrangement for improvement of its acoustics. Heavy wall drapes and rich carpets deaden all sounds originating there and one's voice sounds small and thin as compared with its carrying power outside the chamber. There is also a total absence of echoes.

Something like this will take place when the station is in operation: The studio director gives a brief talk before each concert in which he will stress two points; all talking must cease during the singing, speaking or playing of each number and each number *must* be rendered distinctly. Next the director steps over to the telephone and tells the station operator to start the transmitter. When he receives word that the station has signed on, he signals the artist or artists to start the first number and they group themselves about the microphone.

The director tests the modulation and the audio frequency by listening in on a headset which is connected in series with the line and is therefore able to correct errors in transmission conditions from the start.

In order to make the feeble microphone currents from the studio capable of moulding or modulating the tremendous radio frequency currents radiated from the great

The June number of Radio Age carried an illustrated article on how a photograph was sent by radio from Rome, Italy, to Bar Harbor, Maine, in forty minutes. Transmitting photographs by radio code has since engaged the interest of thousands. Here is Miss Nellie D. Stevens decoding a "radio-photo" of Miss Virginia Valli, Universal Film Star, which was sent from London to New York by wireless. On the artist's drawing board are two portraits of Miss Virginia Valli. The picture on the left of the board is a copy of the portrait transmitted through the air. On the right is the result of Miss Stevens' decoding. She is now engaged in perfecting a method of transmitting finger-prints by radio in the United States. To the left is facsimile of coded portrait as received by Carl Laemmle, President of the Universal Film Manufacturing Company.

aerial, devices known as line amplyfiers are used.

Although the distance between the studio and the station is only a few yards special care must be taken to guard against line losses. For this reason the wires are encased in conduits, which, in turn, is grounded, rendering it incapable of affecting the delicate frequency currents which traverse its core.

From the plate glass panel on the transmitter to the beautiful, draped studio, the Drake Radiophone station is symbolical of the latest developments in the science of radio broadcasting. The very latest is the equipment incorporated in this mammoth transmitter which will hurl the voice and music far out over the land and sea, thousands of miles in every direction. A brief description of the set is all that space permits.

The input to the transmitter is approximately one kilowatt, which will afford ample power to charge the antenna at the tremendous frequency at which the radio waves are propagated. Inasmuch as over ninety per cent of this energy is modulated it can be readily seen that the efficiency of the set is very high. Modulation is accomplished through the use of the huge pliotron tubes which impress the modulated energy upon the grid of the oscillators in such a way that the efficiency is very high. The oscillators in turn charge the aerial with the radio frequency currents which travel through the air to the antenna of the amateur's receiving set.

The aerial at the Drake is of the common "T" type in which the waves are undirectional. The feature of the antenna is the fact that the lead-in is also part of the antenna. This is done by making the lead-in of a small cage type aerial in which the internal resistance is reduced to a minimum. Another feature of the aerial is that of the insulators which are made of heavy plate glass of over an inch in thickness and approximately two feet in length thus insuring against losses and leakages in the antenna system.

Running down the side of the building in the shape of a huge fan we find the counterpoise. This counterpoise is spread out directly beneath the aerial so that the radiation is greatly increased. The added factor of the ability of this counterpoise to keep the grids of the tubes from being drained is another feature worth mentioning. Coupled with a good ground connection a better antenna and ground system could not be desired. But we must turn our attention to the device which supplies the station with the high voltage power necessary to operate the tube set.

Above the main operating room the powerful motor generators are installed. These are of the ball bearing type in which friction is reduced to a minimum. As Mr. Sughart, the chief operator, laughingly put it, they would have to be shut off half an hour before the station was ready to sign off in order to come to a stop when the program was finished. Of course the generators are operated by remote control from the room below as is every other phase in the operation of this station. The voltage from the plate generator, the one which handles the plate current to the tubes, is controlled by field rheostats while the control of the filament generator, the one which furnishes the filament current, is handled automatically by the generator itself.

A big feature of the Drake radiophone station is the fact that microphone lines are to be run to all parts of the hotel to pick up music and conventions held in the hotel. These will be relayed to the station where they will be broadcast. Thus the station can at any time call upon any number of novelties to assist it in the furtherance of the programs.

WDAP is owned and operated by Mr. Thorne Donnelley and Mr. J. Elliott Jenkins of Chicago. These two men have done much to aid the progress of radio in Chicago, and it was due to efforts on their part that Chicago was served with a program on Sunday evenings, the time when a radio concert is most enjoyed. This service will be continued every Sunday and will also be gradually extended until it embraces every night in the week. The station is in charge of Mr. Sughart, whose efforts to serve the public as the public wishes to be served have met with such a great success. So as Mr. Sughart says, "Station WDAP signing off for the evening. Good night."

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Syndicated Music

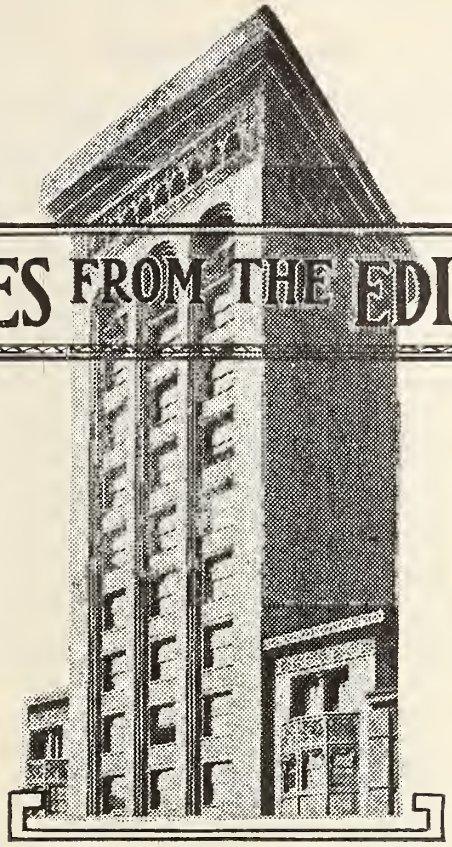
The day may yet come when the whole country will be able to sway to the music of a single orchestra. The Hotel Commodore in New York City has just completed the installation of a radio receiving set and a loud speaking telephone outfit that is attracting considerable attention, particularly among the dancing masters of the East and others who see in it the possibilities of buying their music from one central source just as they obtain their light and heat and power.

The amplifying and loud-speaking apparatus, which has been installed by the Western Electric Company as part of the permanent equipment of the hotel, is similar on a smaller scale to that used at Madison Square Garden on Armistice Day, when 38,000 people in and about the building were able to take part in the service. Projectors have been placed at various points in the ball room and connected through vacuum-tube amplifiers to the radio set. The antenna on the roof of the hotel picks up music sent out by the broadcasting stations and passes the waves through an ordinary type of receiving set in which they are amplified. The power amplifiers then increase the strength of these signals.

"I have been much interested in this demonstration of dance music by radio." says Joseph O'Brien, President of the Dancing Masters Association, in discussing the Commodore equipment. "First class music for dancing is essential if we are to please our patrons and this kind of music costs us real money. It is an obvious waste for a hundred academies to employ a hundred orchestras if they can connect by radio with a central station which transmits dance music. If such a station were established, it could readily afford the best orchestra in the world—one made up entirely of top-notchers. Yet the cost to each subscribing academy would be less than its present payroll. Of course, this would not eliminate local musicians because there always will be need for them to furnish music for instruction and special dancing."

1,000 Radio Patents

More than 1,000 patents have already been issued by the United States patent office covering new designs on materials connected with radio. Between 2,000 and 3,000 patents are pending. With this work ahead of the officials for investigation and approval the patent office is one of the busiest places in Washington.



THOUGHT WAVES FROM THE EDITORIAL TOWER

FIGURES supplied by the Radio Chamber of Commerce estimate that the present number of 1,500,000 receiving sets now in use will be increased to 5,000,000 in the next few years. It is likely that a great percentage of this increase will be derived from the farmer. And that opens an interesting line of discussion.

It cannot be denied that there are hundreds of thousands of farmers who are not yet "sold" on radio. They have heard about it from newspapers, magazines and from visitors from the cities where radio has long been a business convenience and a social diversion. There are several reasons why the farmer, for whom radio one day will open avenues of interest hitherto undreamed of, has not "put in his set."

One reason is that distributors have been so busily engaged in looking after the demand for apparatus in the more densely populated districts that they have not organized the drive on the rural communities. It is sure to come. Another reason is that the crystal set is not effective in getting signals for more than 15 to 25 miles and hosts of farmers live further than that from the nearest broadcasting station.

This raises the problem of the storage battery which is an essential of the set which will give the farmer an adequate radius. Farmers whose houses are not wired for electric lighting are put to some difficulty to recharge their batteries. If their homes were wired they could use easily the standard home-charging device for the purpose. But the farmer who must carry his heavy battery to town to get it charged may ofttimes be most eager to listen in just at the time when his battery is in the doldrums.

We learn of one farmer who used the battery from his automobile for radio at night and for motor purposes during the day. Anybody who has tried to extract one of those heavy batteries from the almost inaccessible spot in which motor manufacturers are fond of bolting them into the car structure will appreciate that this farmer must needs be a super-fan to go to this trouble. He ran the engine of the car for four hours a week during the snow-bound season thus charging his battery for another seven days of markets, music and news by wireless.

Those knights of the open road who have gone hither and thither among the farmers selling them cheap crystal sets on the misrepresentation that the outfits will receive messages from impossible distances are about through with their confidence games. The farmer is getting radio wise in his day and generation and from now on he will have to be shown.

The way to produce the sales of that other 3,500,000 receiving sets is to offer the farmer sets that will perform with a minimum of trouble and expense. Manufacturers who deliver such outfits will find the farmer a willing, yes, almost a profligate spender.

It is a matter of pride with Radio Age that many of our subscribers are of the R. F. D. sort. We should like to hear from farmers and manufacturers, both, as to ways and means of making radio most easily accessible to the rural citizen. He is possibly not the backbone of the radio future but he at least is the ribs of it. Incidentally farmers should be especially interested in the special government article published in this number, explaining how to construct a tube set for $23.

DON'T bomb the broadcaster! He is not only doing the best he can but he is doing very well. Also, in a majority of instances, he is doing his best without cost to the receiver.

Broadcasting stations have made mistakes but they are improving their service as experience teaches better methods. The broadcasting station usually is operated by a business organization that is engaged in manufacturing and selling radio equipment. Broadcasting is a direct and most important method of interesting the millions in radio, because it offers them news and entertainment, not to mention a service which has become indispensable to business. Therefore, it need not be feared that the proprietors of broadcasting stations will carelessly permit their product to decline in merit. They want to improve it.

But broadcasters need help. They need intelligent criticism from operators of receiving sets. They need protection from foolish radio dealers, who turn on their loud speakers to the limit and do their best to convince the public that the studio in the broadcasting station is a cage of roaring, yelping, yipping lions.

"Well, if that's radio, I don't want any of it in my house."

You have heard men and women make that emphatic announcement at radio shows and in radio shops. That exclamation means radio business deferred, if not definitely lost. It is business that might have been saved had the operators of the receiving station toned down their instruments so that human speech, and sweet music would come forth, instead of shrieks of a lost soul.

Broadcasting stations should organize. They should exchange information and ideas as to the best and most popular programs to give the radio millions. They should

combine to oppose the attempted extortions that continually are being practiced. They should know what their rights are in relation to broadcasting copyrighted music. They should stand together to demand that every advantage of the law be taken in putting out of business the ill-mannered fan who breaks up the best of broadcasting programs by sending outside his legal wave-length.

The day of broadcasting talking machine records is past. The public has had just enough of the excellent entertainment by high class artists to be satisfied with nothing less. Such entertainment is available in every big community.

The public wants a mixture of superior music and jazz stuff. It wants a little bit of heavy discussion of civic or social conditions, and a great deal of humor that IS humor. It wants a song from the operatic star, but it also wants the old-time ballad, or the modern song hit.

Many broadcasting stations know the foregoing assertions are true and might be excused, if they called such comments trite. But many others have seemingly failed to get the conviction that broadcasting is the lifeblood of radio. Radio isn't going to gain any new friends through broadcasting of views by an eminent citizen on the moral responsibility of the protoplasm to the scientific aspects of unadulterated blah.

Ben Franklin said, in the perilous revolutionary days: "We must all hang together, or we shall hang separately."

Sad News for the Crooks

(Continued from page 9.)

sioner Enright and M. R. Brennan, superintendent of the police telegraph division, to send on a 400 meter wave length. Later, if the Department of Commerce has to allow a wider scope to present users of the 360 meter wave, the New York police will be permitted to widen their range to 500 meters.

"We have already made arrangements," Mr. Brennan said yesterday, "to equip our police boats and inspection district offices with radio telephonic receiving sets. As we progress with the idea, receiving stations will be installed in all precinct headquarters and special operators will be detailed to attend them twenty-four hours a day. When the other larger cities take to radio telephony for administrative purposes, we expect to be able to establish a network of broadcasting and receiving stations that will make it possible to give a national alarm almost instantaneously."

How to Kill Radio

BROADCASTING is the heart of the radio game, public, private commercial, educational.

If transmission is poor radio listeners are going to be discouraged.

If programmes are inferior and poorly balanced casual dabblers in radio are not going to be influenced thereby to buy apparatus and get into the game in earnest.

Broadcasting of grand opera in Chicago last year started a demand for receiving sets that amounted to a "craze."

Broadcasting has made the radio business and broadcasting can kill it.

How to Construct a Tube Set

(Continued from page 8.)

tube to be much more positive in adjustments than the crystal detector.

Notes on Soldering

It has been stated above that certain connections were soldered. In fact, one could well advise that all connections about a radio circuit be soldered, but soldered correctly. There are some general hints that may be given but judgment and experience are essential. (1) The soldering copper must be clean and the tip well coated with solder. If the tip of the soldering copper is not bright, it should be filed clean. It is then heated, care being taken that the tip is not directly in the flame. After the copper is hot —not red hot—it is dipped in the soldering flux or paste and the copper tip coated with solder. (2) The wires are cleaned where the soldering is to be done, using fine sandpaper, then a small amount of soldering flux or paste is applied at the joint, and the wires to be soldered are tinned or coated with solder before the wires are joined. After the wires are tinned they are soldered together, using just enough solder to make the joint solid. The joint should not be jarred while the solder is still soft; to do so weakens the joint and gives the solder a dull appearance. A good soldered joint will be smooth and bright. (3) All excess soldering flux or paste should be cleaned off. Gasolene or alcohol will assist in cleaning off the paste. This last point is sometimes overlooked and the excess of flux often causes the copper wires to corrode.

Cost of Parts

The following list includes the cost of parts of the electron tube detector unit and the "A" and "B" batteries. It does not include the cost of the telephone receivers or of any of the other equipment used to make up the complete receiving outfit given in the previous description of the simple crystal receiving set.

Electron Tube Detector Unit.

Electron tube	$5.00 to $6.50
Electron tube socket	0.75 to 2.00
Filament rheostat	1.00 to 2.50
Grid leak and grid condenser	0.50 to 1.50
By-pass condenser about	0.35
Ten (10) feed No. 14 bare tinned copper wire about	0.10
Miscellaneous binding posts and screws, about	0.75
Batteries:	
"A" storage battery, 6-volt, 60 amper-hour capacity	$15.00 to $20.00
"B" battery, 22 1/2 to 45 volts	1.00 to 3.00
Total	$23.25 to $36.70

Signal Electric Co. Expands

The Signal Electric Manufacturing Company of Menominee, Michigan, has acquired the Hulbert patents and taken over the assets and liabilities of the Hulbert Electric Manufacturing Company, of Chicago, Illinois.

Under this arrangement production of the Hulbert Battery charger will be increased and others of the Hulbert patents will be developed and put into production.

Mr. C. H. Hulbert will hereafter be identified with The Signal Electric Manufacturing Company, in the capacity of research and development engineer.

400 Meters for KYW

Chicago's KYW, the Westinghouse broadcasting station on the roof of the Commonwealth Edison building, has been raised to the B class and its wave length has been made 400 meters, instead of 360 as formerly. The change was made with the authority of the government radio inspector because of the increased importance of the station following its erection of new aerial towers and other additions and improvements. The new wave length was used for the first time on Sunday, September 17.

Expert Explains Radio Frequency Amplification

Interesting Facts About Phenomenon of Wireless Telephony

By CHARLES KILGOUR

Radio Engineer for Crosley Manufacturing Co.

In an Interview

ALTHOUGH radio frequency amplification is no mystery to the average wireless telephony amateur, there are many, especially those who have but recently become radio fans, who will be interested in a brief explanation of this phenomenon. Mr. Charles Kilgour, radio engineer, who is in charge of the corps of engineers employed by the Crosley Manufacturing Company, operators of the radio station WLW, in Cincinnati, Ohio, has made a close study of radio frequency amplification, and, in a discussion of it, said:

"Everyone knows the purpose of the ordinary two stage amplifier is to make louder the sound as originally received through the detector tube or crystal. This amplifier makes any audible signal louder; therefore, it is called an audio frequency amplifier.

"The extremely weak electrical alternating currents induced in the antenna circuit of the receiving set have a frequency far too high to produce an audible effect on the head phones. Broadcasting stations usually use the 360 meter wave length, which means that the current picked up has a frequency of more than 800,000 cycles per second. The lowest note of the piano or organ has about 16 beats, or cycles, per second, while the highest beats approximately 8,000 times per second.

"The high frequency current picked up from the broadcasting station is called a radio frequency current, because it is at this high frequency that the message is radiated through space. Combined with the radio frequency pulsation there is a low frequency variation which is the part we wish to hear. The detector so alters the current that the high frequency part has no effect on the head phones while the low frequency part acts upon them, causing them to give out an audible note. This is called rectification.

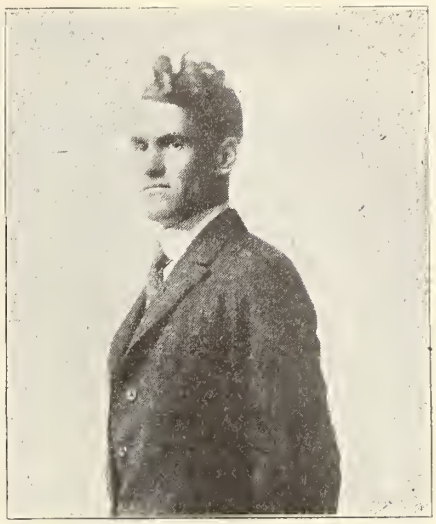
"Understanding this, it is apparent the name indicates that a radio frequency amplifier does its work before the detector has acted. It is inserted in the set between the tuner and detector. As in the case of the audio frequency amplifier, a vacuum tube with its proper circuits is used to strengthen the electrical current. In this case, however, this is accomplished before the current has been rectified by the detector. One stage of radio frequency amplification will not have as great an effect on the output as a single stage audio frequency amplifier of proper design, but it has several advantages.

"If a great volume of output is desired, why do we not use more stages of audio frequency amplification? We cannot ordinarily use four or six stages because audion amplification becomes very noisy when cascaded in this manner and sounds generated in the tubes themselves have a tendency to drown out the signal. On the other hand, a radio frequency amplifier does not have this bad quality in anything like the same degree.

"There is another important advantage derived from the use of the radio amplifier. Detector tubes fail to rectify very weak signals so there is nothing for the audio frequency amplifiers to work with, no matter how efficient they may be. A properly designed radio frequency amplifier, however, will strengthen these weak signals to such an extent that the detector will do its work properly and the audio frequency amplifier will make the sounds boom out in the head phones or loud speaker. Properly designed radio frequency amplifiers are very successful and open a new field of enjoyment for those who 'listen in.' "

That Reinartz Article

The illustrated article on the Reinartz unit, how to make it and what it will do, and why, seems to have aroused interest from Boston to San Francisco. If you missed the September number you may obtain one by sending twenty-five cents in stamps to Radio Age, 64 West Randolph Street, Chicago. Better write today. Supply is limited.



Charles E. Kilgour, writer of the article on this page in which radio and audio frequency is explained, is the man who supervised construction of the Crossley Manufacturing Company's new broadcasting plant at Cincinnati, Ohio. Mr. Kilgour is a radio engineer and a good one. Also, as will be observed by those who read his interview, he knows how to tell what he knows.

Radio Combine in England?

English officials are at logger-heads over a proposal of Postmaster General Kellaway to grant the exclusive right of broadcasting and the monopoly of the sale of receiving instruments. This plan contemplates barring American and other foreign-made radio equipment from the English market and would place the sale of equipment in the hands of a combine of instrument makers.

Opposing this proposal Capt. Wedgewood Benn, member of parliament, argued that radio is supplementary to the daily press. He denied the right to limit its transmitting facilities to a combine. He said radio was the most important social development since the discovery of printing.

It is predicted that $30,000,000 will be spent in England in two years by this combine in buying receiving apparatus and building broadcasting stations and that 80 per cent of this sum would be paid to labor. Mr. Kellaway said there would be no monopoly and then went on to explain that all of the English manufacturers could become members of the company. He said the English should "keep this new form of communication in the hands of our own people."

Localizers for Airmen

A device to use electro-magnetic waves in assisting an aviator in determining when he is above a landing field has been produced by the United States air mail service after experiments covering three years. The apparatus is called a "localizer." Briefly, it transmits radio signals in practically a perpendicular direction and these, penetrating fog or clouds, reach the aviator and inform him of his location. The device will greatly assist aviators in night flying, it is anticipated.

Chicago's International Radio Show

Exhibits by Manufacturers Will Predominate and There Will be Abundance of Features for Crowds

Arrangements are complete for the Chicago radio show which will be open to the public on October 14 to October 21 at the Coliseum. The exposition promises to be one of the most important trade displays ever assembled in the country. Directors of the show announce that practically every large manufacturer of radio apparatus in the country will be represented. The presence of manufacturers in large number will make the show distinctive in that it will not be a bazaar, but an exposition of the progress radio science has made.

It is announced that this is the first radio show to receive indorsement by the National Radio Chamber of Commerce and by the Radio Division of the national electrical manufacturers. The preponderance of manufacturing exhibits is expected to bring large numbers of jobbers and dealers to Chicago for the purpose of getting a line on the latest improved radio merchandise.

It will be the first time that the manufacturer has taken the opportunity to meet the jobber, dealer and the public all at the same time. Aside from the show it will be a sort of a great get-together convention for all those interested in radio. Meetings of some of the most important committees of the National Radio Chamber of Commerce will be held at the same time.

An elaborate entertainment program is rapidly being arranged. Ed Wynn, the famous comedian, and his company will put on their show the opening night of the exposition and it will be broadcast. There will be a society night, a radio ball, a children's afternoon and other features during the week. While the entire Coliseum will be given over to the exhibits, the Coliseum Annex will be given over to meetings, entertainment, the radio ball and other features.

The remainder of the exhibition space is being rapidly sold, the amount already taken insuring the success of the exposition from the standpoint of both the exhibitor and the spectator. There will be plenty of room for the crowds, as sixty per cent of the entire floor of the Coliseum will be used for aisles, preventing overcrowding and giving the exhibitor a chance to talk to his prospective customers.

The public will be well entertained. The exhibits will include the latest radio apparatus, many exhibits being of improvements made during the summer and shown for the first time. There will be novelty exhibits and a score of aerials on the roof of the Coliseum will catch and disseminate all that is being sent out from the broadcasting stations all over the country.

In the large space in the center of the building will be a display of radio controlled automobiles, torpedoes, a pump that pours out real water and other mechanical devices operated from a small sending station.

U. J. Herrman, managing director of the Chicago Radio Show, and Manager James F. Kerr visited more than a dozen radio shows in different parts of the United States before making their final plans for Chicago's show and thus have been able to avoid the mistakes made by the other shows. The Chicago Radio Show will be an annual affair and holds an exclusive lease on the Coliseum for this kind of a show and for a long term of years.

Two Cincinnati Shows

CINCINNATI claims to be the greatest radio center in the United States, in proportion to its population. It cannot be denied that the Ohio city had taken hold of the wireless game with an enthusiasm to be marvelled at. Any visitor to Cincinnati will be struck by the number of radio aerials he sees strung up on the roofs of buildings, especially in the business districts. One of the reasons for this abundance of aerials is that the Crosley Manufacturing Company, operators of station WLW is almost continuously "on the air" with interesting news, entertainment and market features.

Cincinnati is to have two radio shows this month, the first of which will be known as the Radio and Electrical Exposition, while the second will be conducted by the Tri-State Tobacco Growers' Association. The Radio and Electrical Exposition will be conducted in Music Hall, October 2-7, while the Tri-State Tobacco Growers will conduct their exposition in Covington, just across the Ohio River from Cincinnati, October 21-28. The latter exposition will be one of the largest of its kind ever conducted in the Middle West, President Harding and the Governors of Ohio, Kentucky and Indiana having promised to be present.

Porcelain Sockets

Many radio manufacturers and thousands of amateur operators have adopted the Crosley Vacuum Tube Socket because of its many advantages over more complicated and less efficient ones. This socket is made of one piece of porcelain, the same material that is used in the base of a vacuum tube to insulate the four prongs. The contacts are of special, strong phosphor bronze, nickel plated, which eliminates to a great degree corrosion at the contacts. The nuts and screws are brass, nickel plated.

As the socket is made of porcelain, wires can be soldered to the contact posts without fear of melting the material of which the socket is made, and it will be found that it will not be affected by overheating of the tubes. The bayonet slot, imbedded in the wall of porcelain, is completely backed up and reinforced to prevent the possibility of breakage, and as the barrel that surrounds the tube is made of porcelain, there is no possibility of ground hum, so often noticed in sockets having a metal wall.

This socket was designed to prevent short circuiting of high voltage "B" battery current across the filament contacts, thus eliminating the danger of burning out the filament through careless insertion of the tube. This feature appeals especially to the dealers who are called upon to replace tubes that have been burned out as a result of use in ordinary sockets.

The Crosley Sockets have another unique feature in that they can be mounted either on a base or panel.

Injunction Granted

An important step in clearing up the somewhat tangled situation regarding radio patents was taken by Justice O'Malley of the Supreme Court in granting the injunction asked by the Freed Eisemann Radio Corporation of New York against the Wireless Specialty Apparatus Company.

It is stated that the Wireless Specialty Apparatus Company recently published a series of statements which indicated that crystal radio receiving sets are controlled by patents owned by them.

The contention of the Freed Eisemann Radio Corporation, now sustained in the courts, was that these statements constituted unfair business competition and an injunction was granted restraining the Wireless Specialty Apparatus Company. The injunction was part of the suit. The balance, in which $150,000 damages was asked is still pending.

The outcome of the suit, it is said, will have an important bearing upon the entire crystal radio patent situation.

Questions and Answers

This is the "trouble department" of Radio Age. No trouble to us, but representing difficulties of our readers. Many letters are received asking what charge is made for answering questions as to hook-ups, etc. This is a free service department and all questions will be answered without charge, either in the magazine or, if self-addressed and stamped envelope is sent, we will send the answer promptly by mail. This department is conducted by Frank D. Pearne, Technical Editor of RADIO AGE.

F. L. G. Chicago, Ill.

Question: Will you kindly inform me if good results can be obtained by using honey-comb coils as loading inductances? If this can be done, will you please mark the enclosed diagram, showing where they should be inserted, so that condensers will be in shunt around them. If there is any charge for this service, I will gladly remit upon being notified of the amount of same.

Answer: Yes they will work very well, but in this particular case you must have a coil consisting of 70 turns, tapped at a point 20 turns from one end as shown in the diagram returned by mail. This can be done very well by winding 70 turns of No. 26 wire on a plain tube 2 3-4 inches in diameter and tapping at the twentieth turn. This will bring your set up to something more than 600 meters. If you want a greater wave length use more turns and tap of the intermediate contact in the same proportion. Thanks for your offer to pay the charges, but this service is already paid for when you buy the magazine. It is furnished free to the readers of Radio Age.

T. J. S., Boston, Mass.

Question: In your September number of Radio Age I saw your Reinartz tuner. I have started to make same and would like to make one step of amplification to start with. Can you send me any more information as to the construction of same? I have the enclosed list of apparatus, so I have a good start. I started to make a radio receiving set with two steps of amplification described in another magazine and got as far as the first stage of amplification and it did not sound good. As I have made three sets of the crystal type and had good luck, I want to hear from you before going ahead.

Answer: I do not know of anything which I might add to the instructions given in the September number. All I can say is, go ahead and if you find anything which you do not understand, just write to me and I will be very glad to help you. I think that after you get started you will find the set quite easy to construct.

B. L. H., Danville, Ill.

Question: I am starting to set up a transmitting station and come to you for some information. Do I have to pass an examination before I can do this and if so who will give it to me, and where? Can you tell me anything about what this examination would be? That is, do I have to be able to send at any certain speed and what is the nature of the questions that will be asked? Do you recommend any special type of antenna for a transmitting station? If so, will you please send me a description of it, as I want my station to be a good one.

Answer: Yes; you will have to pass an examination before you will be allowed to send messages. You can find out all about this by writing to the United States Radio Inspector, 9th District, Federal Building, Chicago, Ill. The ability to send is not so important as how much you can receive. For an amateur license you will be required to receive 10 words per minute and you will have to be able to tell the function of all parts of your set and answer the other questions asked by the inspector. Use a "T." aerial for sending. The following diagram will show you how to construct it.

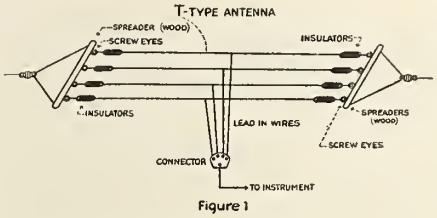
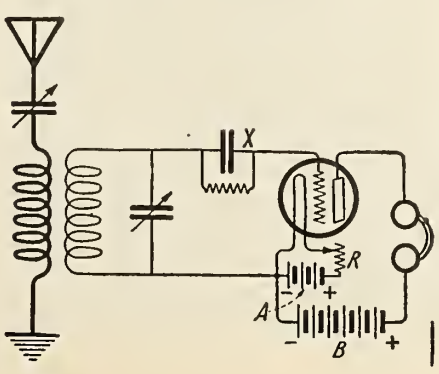


Figure 1

B. B., Levering, Mich.

Question: I have been very much interested in the questions and answers in your magazine and want to ask several questions myself. I am within a few miles of the Straits of Mackinaw, and want to be able to hear as far as Atlanta. With ready made parts, I have hooked up a receiver as shown in the enclosed diagram. With this set I have heard Pittsburgh, Louisville, Davenport and faintly from Atlanta. Is there any suggestion you could make to improve it? Do you think a variable condenser in the aerial would improve it? Will you please send me a hook-up for one stage of radio and two of audio frequency to go with this set?

Answer: If you get these results, don't change your set. Variable condenser in your aerial circuit will help, providing your aerial is not too small. I am mailing you the desired circuit.



C. C. T., Garner, Iowa.

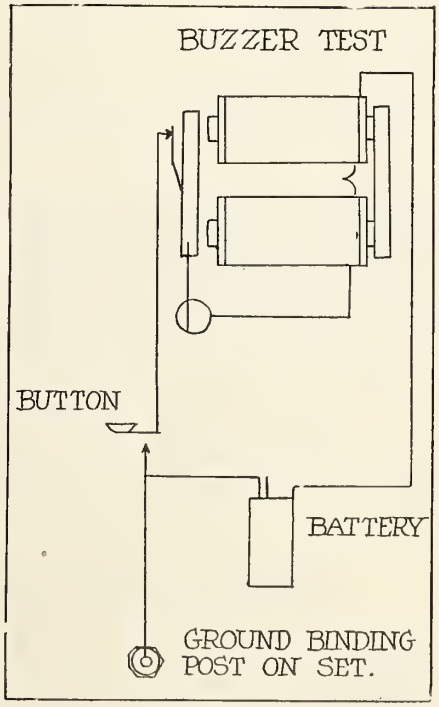
I noticed the "super" hook-up in the Radio Age this month and am wondering if it is strong enough to use a loud speaker in place of the phones for stations 500 or 750 miles distant? Will it be advantageous for me to use an aerial instead of a loop?

Answer: Yes, a loud speaker can be used with this circuit. Do not try to use an aerial on this set, but stick close to the directions. The values and constants have been carefully figured out and any change may upset the entire plan. I have experimented personally and found the loop gives better results.

W. Y., Jr., Muskegon, Mich.

Will you kindly send me a pamphlet or details of how to make a vario-coupler? Also please send me a wiring diagram to use a vario-coupler with an audion detector and one variable condenser. Give all the details possible in the construction of the vario-coupler.

The description of the vario-coupler will require too much space to print here, so I am sending it by mail. Connect it to the circuit as shown on this page.



E. B. F., Lansing, Mich.

I have a crystal set which I made myself. When I can find the adjustment on the crystal I get very good results, but this does not happen very often. As you can see I have a buzzer test hook-up connected to the set but cannot hear the buzzer in the phones, so it doesn't do any good. Is it connected right? I have tried it several different ways and can hear it outside of the set, but it won't come through the phones. If you can show me how to connect it to my aerial I will appreciate it very much.

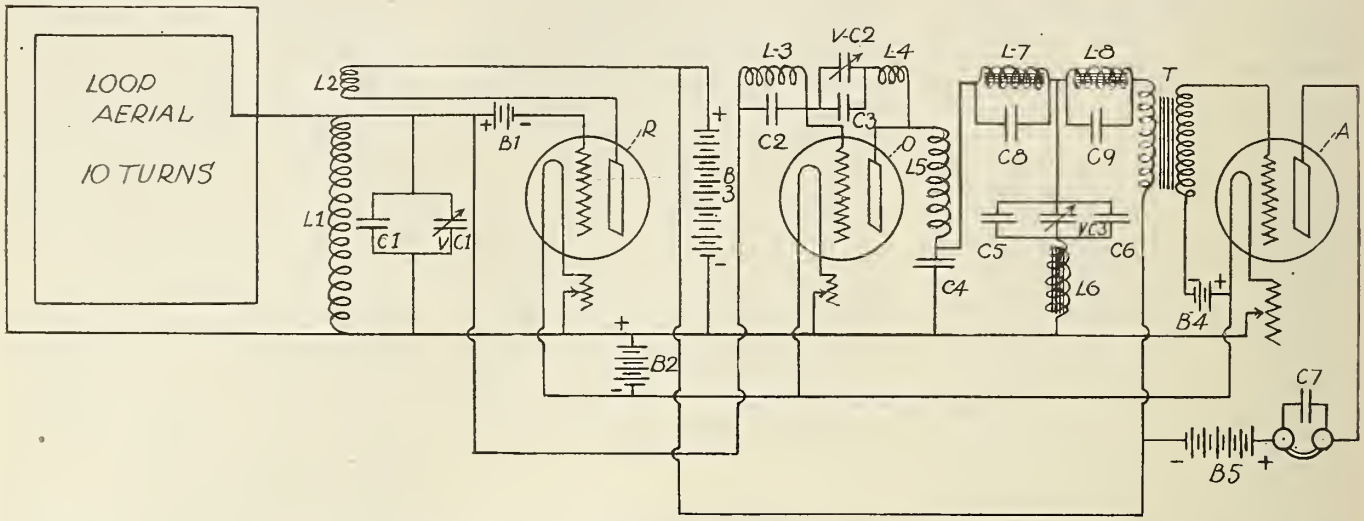
Answer: The hook-up which you

(Continued on page 22.)

Armstrong Super-Regenerative Circuit

3-Tube Arrangement

ARMSTRONG SUPER-REGENERATIVE CIRCUIT.



QUITE a number of Armstrong super-regenerative circuits have been published in the different papers and magazines, some of which, when tested out, will give results and some will not. This makes the question of amateur construction rather vague and uncertain and many who want to construct a set of this kind have decided to wait and let the other fellow work them out and find the best circuit, before spending any time and money on it. The circuit here shown has been used with some success by amateurs and seems to work better than any of the others.

At times very good results have been obtained and frequently the results are not so good, which seems to show that the circuit is all right, but that the trouble must be in the proper adjustment of the many controls. This being the fact then, it would seem that the whole matter resolves itself into the question of the user becoming well enough acquainted with the set to know just what is the cause of this variation in efficiency. For the benefit of those who wish to construct this circuit, the following list of apparatus used and their values are given.

M-1- Fixed condenser .0005 M. F.
M-2- Fixed condenser .0025 M. F.
M-3- Fixed condenser .0005 M. F.
M-4- Fixed condenser .005 M. F.
M-5- Fixed condenser .002 M. F.
M-6- Fixed condenser .002 M. F.
M-7- Fixed condenser .0005 M. F.
M-8- Fixed condenser .002 M. F.
M-9- Fixed condenser .002 M. F.
L-1- is the stator of an ordinary vario-coupler. L-2- Vario-coupler rotor. L-3- is a 1250 turn honeycomb coil. L-4- 5 Milhenries inductance coil. L-5- is a 1500 turn honey-comb coil. L-6- .1 Henry inductance coil. L-7- .1 Henry inductance coil. L-8- .1 Henry inductance coil. T- Audio frequency transformer. V.C.-1- .0005 Variable condenser. V.C.-2- .0005 Variable condenser. V.C.-3- .001 Variable condenser. B-1- 2- to 6-volt dry battery. B-2- 6-volt storage battery. B-3- 90-volt battery. B-4- 22½-volt battery. B-5- 200-volt battery. The loop aerial should consist of a few turns of No. 18 wire wound on a 4-foot frame. The exact number of turns for any particular set will have to be found by experiment. It usually requires from 6 to 12 turns.

Questions and Answers—Continued

show is wrong, but I don't see how you can help hearing it in the set. The accompanying arrangement will give you a buzz in the phones if you will connect it as shown.

N. E. L., Sault Ste. Marie, Ont., Canada.

I have read your article on the Reinartz tuner in the September issue of the Radio Age with a great deal of interest and intend to construct a set just as soon as I can gather together the necessary material. If not inconveniencing you too much I should certainly appreciate it if you give me some information as to how to tune it. If you have any other information you can give me along these lines, it will be most gratefully received.

Answer: I am glad to know that you intend to build this set, as I have had nothing but good reports from the many fans who are using them. I have not heard of one failure. The adjustment for tuning is quite simple. There are three switches and two or three condensers (according to which one you decide to construct). The switches should be set in one position and the dials on the condensers moved back and forth. If no sound is heard, move the switches to different positions and try again with the condensers. Continue in this way until a station is heard and then change the adjustments until the signals come in clear and plain. The filaments of the tubes should be turned up until they burn brightly, but not bright enough to destroy them. You will soon learn just where to set all the controls to get the best results, as it is only a matter of practice.

J. H. C., Chicago, Ill.

I like your questions and answers very much and read them all with great interest. I want to ask you one question which is not clear in my mind. Why is it that on most all radio frequency circuits they always say to use a loop antenna? Can I use my outside aerial which is 90 feet long with two wires and about 35 feet high, instead of the loop? If not, will you please tell me why?

Answer: The reason you are advised to use a loop aerial is because radio frequency, while it will bring in the distant stations very well, will also greatly magnify static and interference. The loop aerial is particularly adapted for this work because it eliminates much of this trouble, which will bother you considerably if you use the outside aerial. Stick to the loop for good, clear music.

INTERNATIONAL AND ANNUAL

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Radio Guides Ships

A loop aerial receives loudest signals only when its edge is pointed in the exact direction from which the signals are being sent. In this way, it is possible to tell the exact point of the compass from which a station is operating.

The United States government has developed this radio compass principle into a complete chain of stations for the purpose of giving the captain of a ship his exact position whenever he asks for it.

This chain is made up of a series of units, each comprising a central station and two compass stations.

Let us suppose that the ship's call letters are WIY and that the call letters of the control station are NUT.

The ship desiring to learn her position calls NUT and, when NUT answers, makes the signal "QTE?" which means "What is my position?"

The station NUT then instructs the ship's operator. to make the letter V repeatedly for one minute, interpersing the letters with its call letters and, at the same time, NUT sends instructions over the private land wires to the two compass stations to listen for these V's and take their bearings.

It is a matter of only a few seconds for the compass stations to do this. We will assume that the compass station to the East finds that WIY's signals are coming from 240 degrees and the station to the West finds that they are coming from 130 degrees. The compass stations immediately telegraph over the land wires these two bearings, the officer in charge of NUT "projects" the two bearings on the large chart on his table and the point where they cross is inevitably the position of the ship.

Almost before the minute is up this officer has figured the ship's exact latitude and longitude and, as soon as WIY has finished his V's, NUT sends him by radio his exact position.

These radio compasses have been developed to such an extent that they are accurate within one degree and this is sufficient for any ship to steer a true course down the coast.

This means that the navigator of today on the coasts of the United States is independent of fogs or darkness or any of the elements which so frequently combine to force a skipper to resort to the uncertain methods of "dead reckoning" for days at a time.

Present Stock O. K.

E. E. Bucher, general manager of the Radio Corporation of America, says no discoveries have been made recently that revolutionize present radio equipment. He made the assertion in an address to the convention of electrical jobbers recently held in Chicago. Many jobbers had expressed a fear that their stocks might be rendered obsolete on account of progress in efficient equipment. Mr. Bucher told them that electrical experts were working ceaselessly on new developments but that none thus far need lead dealers to junk their stock or give it away at a low figure.

Radio Needs Trained Men

Radio is sweeping the country like wild fire. Thousands of dollars are being spent for expensive outfits. RADIO EXPERTS are needed everywhere to keep this equipment in order and to sell and install new outfits.

Be a Radio Expert

I will train you quickly and easily in your spare time, to become a RADIO EXPERT so you can install, construct, repair and sell Radio equipment. I am a **Graduate Electrical Engineer** and from actual experience I will give you exactly what you must know to make the really **big money in radio.**

FREE My Consultation Service to you is FREE. This outside help which I gladly give you is, in itself, worth more than the small cost of the Complete Course.

START NOW

Don't let others beat you to the big money. **Start now** and within a few weeks' time I will train you at home, at an amazingly low cost, to become a RADIO EXPERT. Write for **"Radio Facts"** sent **free** without obligation.

A. G. MOHAUPT, Electrical Engineer
American Electrical Association
Dept. EY, 4511 Ravenswood Ave. Chicago

WRITE TODAY

FREE to Radio Fans

Illustrated photo-diagrams and prints, with complete working drawings and instructions for assembling your own radio receiving set from standard parts. MAKE YOUR OWN RADIO SET in a few hours' time. So simple that ANY 12-YEAR-OLD BOY CAN DO IT. *Write today.* You will also receive our literature FREE, describing our standard radio parts which we sell you direct from the factory at BARGAIN PRICES.

Metro Electric Co. Dept. 8 1422 W. Randolph St. **Chicago, Ill.**

Did *You* Ever Hear of Lightning Striking Radio Antennae?

IT is generally agreed that telephone wires, electric service wires and metal bathtubs constitute a greater menace from lightning than do outside radio receiving aerials. It is best, however, for the radio operator to follow the advice of the insurance underwriters and install a lightning arrester in his lead-in.

Elimination of the outside aerial will do away with the possibility of danger from lightning. The rules laid down by the national board of fire underwriters concedes this, as they do not regard a receiving set with an indoor antenna as a hazard. Tentative rules of the board are as follows:

Rule 86—National Electric Code —Radio Equipment.

(For receiving stations only.)

Antenna—(a) Antennae outside of buildings shall not cross over or under electric light or power wires of any circuit of more than six hundred (600) volts or railway, trolley or feeder wires; nor shall it be so located that a failure of either antenna or the above-mentioned electric light or power wires can result in a contact between the antenna and such electric light or power wires.

Antennae shall be constructed and installed in a strong and durable manner and shall be so located as to prevent accidental contact with light and power wires by sagging or swinging.

Splices and joints in the antenna span, unless made with approved clamps or splicing devices, shall be soldered.

Antennae installed inside of buildings are not covered by the above specifications.

Lead - In Wires — (b) Lead-in wires shall be of copper, approved copper-clad steel or other approved metal which will not corrode excessively and in no case shall they be smaller than No. 14 B. & S. gauge, except that approved copper-clad steel not less than No. 17 B. & S. gauge may be used.

Lead-in wires on the outside of buildings shall not come nearer than four (4) inches to electric light and power wires unless separated therefrom by a continuous and firmly fixed nonconductor that will maintain permanent separation. The nonconductor shall be in addition to any insulation on the wire.

Lead-in wires shall enter building through a noncombustible, nonabsorptive, insulating bushing.

Protective Device—(c) Each lead-in wire shall be provided with an approved protective device properly connected and located (inside or outside the building) as near as practicable to the point where the wire enters the building. The protector shall not be placed in the immediate vicinity of easily ignitable stuff, or where exposed to inflammable gases or dust or flyings of combustible materials.

The protective device shall be an approved lightning arrester which will operate at a potential of five hundred (500) volts or less.

Protective Ground Wire—(d) The ground wire may be bare or insulated and shall be of copper or approved copper-clad steel. If of copper the ground wire shall be not smaller than No. 14 B. & S. gauge, and if of approved copper clad steel shall be not smaller than No. 17 B. & S. gauge. The ground wire shall be run in as straight a line as possible to a good, permanent ground. Preference shall be given to water piping. Gas piping shall not be used for grounding protective devices. Other permissible grounds are grounded steel frames of buildings or other grounded metallic work in the building and artificial grounds such as driven pipes, plates, cones, etc.

The ground wire shall be protected against mechanical injury.

Wires Inside Buildings—(e) Wires inside buildings shall be securely fastened in a workmanlike manner and shall not come nearer than two (2) inches to any electric light or power wire unless separated therefrom by some continuous and firmly fixed nonconductor, making a permanent separation. This nonconductor shall be in addition to any regular insulation on the wire.

Receiving Equipment Ground Wire—(f) The ground conductor may be bare or insulated and shall be of copper, approved copper-clad steel or other approved metal which shall not corrode excessively under existing conditions, and in no case shall the ground wire be less than No. 14 B. & S. gauge, except that approved copper-clad steel not less than No. 17 B. & S. gauge may be used.

The ground wire may be run inside or outside of building. When receiving equipment ground wire is run in full compliance with rules for protective ground wire in section (d), it may be used as the ground conductor for the protective device.

What Steinmetz Says About Radio and Lightning:

DR. STEINMETZ, who is an authority on high power electrical phenomena, was asked the following question during his visit to the Radio Congress:

Question: Dr. Steinmetz, many of us have amateur radio receiving sets in our homes. We have heard rumors that the Underwriters consider that there is a fire hazard because of the antenna and the ground connections and that certain restrictions may be placed on amateur installations.

Answer: There is no hazard in the amateur radio receiving station. It involves no fire risk nor risk to life. It is merely a harmless toy, but is a great deal more than a toy. It is one of the most valuable developments of the last years, by its instructive and educational value and the recreation and pleasure which it supplies. It would, therefore, be very regrettable if by a misguided public opinion obstructions were placed in the way of the fullest and freest developments of the amateur radio station. With regard to the possible lightning risk from the grounded antenna, first—the lightning risk in a city is very remote in any case and, second—the grounded antenna rather acts like a lightning rod and exercises a protective action against lightning. Any danger from the radio power received by the amateur station obviously is ridiculous when considering that the energy of a single pound of coal would be more than enough to operate the radio receiving station continuously for over a thousand years.

From a Statement Issued by

THE RADIO CORPORATION OF AMERICA

Get Your RADIO AGE Free!

Let us send you for one year a radio magazine that prints radio news when it is news.

Get, without cost to yourself, a monthly revised list of new broadcasting stations in your district.

Get the earliest news of the new circuits with best diagrammatic drawings in the field.

We have a service department for readers covered free by an expert. Ask him about your hook-up and the mails bring a prompt reply.

Get all this free for one whole year!

HOW?

Get two of your friends to subscribe to RADIO AGE and send their names with $4.00 to RADIO AGE and we will give you a year's subscription free.

Address

64 West Randolph St.

Chicago, Ill.

Radio Transmits Power

DISCUSSION by Charles P. Steinmetz of radio power transmission, as published in the September number of Radio Age has acquired new interest because of recent experiments on the Pacific Coast in which power was transmitted over a distance of eight miles. It was the contention of Dr. Steinmetz that the probability of power transmission by directed radio was very small, except in special cases where the distances were moderate and the efficiency of transmission of secondary importance.

Wallace E. Vail, President of the United States Radio Corporation, announces in San Francisco that engineers in the service of that company have demonstrated the feasibility of power transmission and that they are now devoting their energy toward perfecting the apparatus so that results can be obtained at great distances.

Mr. Vail is quoted as saying that it was demonstrated that power could be directed over electromagnetic waves sufficiently strong to be of use for industrial purposes and that the experiments proved that directed radio could be made of tremendous importance in warfare.

A large ship's bell placed nearly a quarter of a mile from the sending apparatus was rung at will during the demonstration. Engineers were unanimous in declaring that a powerful weapon will be available for the United States government when the machine is perfected.

Capable of passing through metal and concrete, the power waves could be used to explode the ammunition magazines of the largest battleships, far beyond gunshot of the American coast, Mr. Vail declared.

Today, in its imperfect state, the contrivance has lighted an electric light from a distance of eight miles, has rung a bell over the same distance, and this in spite of the fact that no effort has been made to focus the radio energy as the inventor Marconi has recently done.

Engineers declared that if the invention of Marconi could be incorporated in that of the radio concern, possibly unheard of results might be accomplished.

Mr. Vail today declared that applications have been made to

(Continued on next page.)

The Combat Radio Battery Is The Choice Of Experts

"I have used Combat batteries in my work and at school for the past 10 years and consider them the highest type of battery constructed. I am now using the Combat Radio in my Radio work"—says Frank D. Pearne, noted Radio authority and teacher.

CHic c c c a Go—messages like that are the great bane of Radio. They are caused by voltage variation—and the Combat "A" uniform voltage Radio battery corrects voltage variation. The extra-heavy, hand-pasted plates in the Combat Radio deliver a discharge that is slow and uniform, thereby eliminating distorted messages. Made exclusively for Radio work—if you own a vacuum tube set you need it. The Combat

Radio is built into a handsome acid-proof steel case which houses the one-piece hard rubber jar. Special composition between protects against breakage or leakage. Patent vent plug allows escape of gases but no acids. Well in jar insures against spilling while filling or charging. Patented non-corroding terminals keep your connections clean at all times—no short circuiting. Fully guaranteed for 2 years by the manufacturers who enjoy reputation of 14 years' high-grade battery making.

SPECIAL OFFER: 5,000 will be sold direct to users at factory prices in order to introduce. This is an opportunity to save money on the best Radio battery ever produced. Some Combats have given as high as 8 years continuous service. Great length of life more than makes up for any difference in price. Take advantage of this offer NOW. Act Quick to Buy at These Prices.

Full capacity 6 v., 60 amp.....$15.25
Full capacity 6 v., 80 amp..... 16.85
F. O. B. Chicago

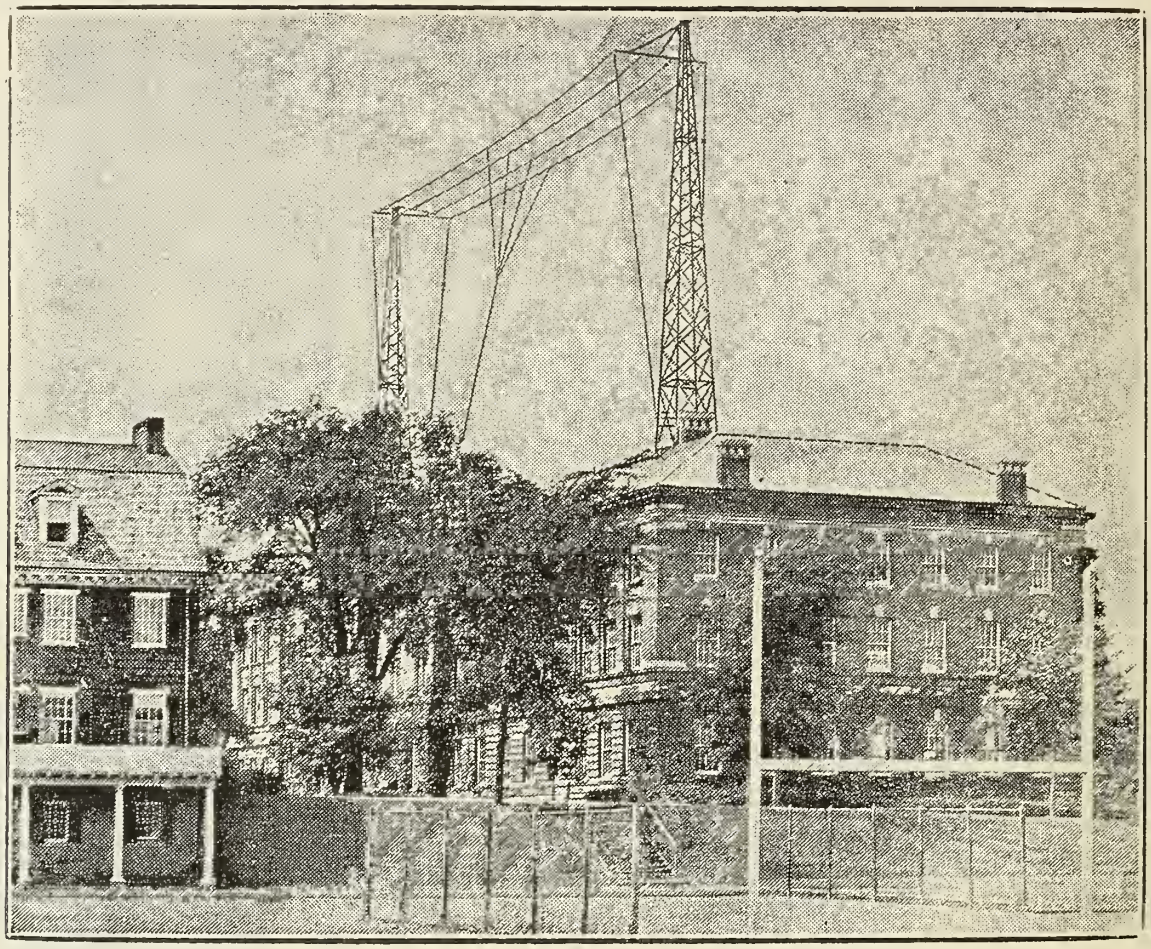
Send only $1.00 as good faith and we will ship C. O. D. subject to examination

Territory still open for live dealers.

Commercial Battery Co.

757-59-61 BOSTON AVE. Dept. A. CHICAGO

Biggest College Broadcasting Station



Coincident with the opening of the college year, a new and unique radio broadcasting station, officially listed in the Government call book as W H A Z, was opened under the direction of the Electrical Engineering Department of the Rensselaer Polytechnic Institute at Troy, New York, and radio receivers from coast to coast may listen-in during the coming season on interesting and entertaining programs of a different sort, while the youthful researcher in the field of scientific development, especially along the lines of his favorite hobby, may gather much valuable information. This new broadcasting station is the most powerful in an educational institution in this country and has a range as great as any continental equipment so far established. In fact, there are only about half a dozen stations of such size and power in operation.

The Troy Polytechnic broadcasting station was made possible through a large gift from Washington A. Roebling, the late Charles G. Roebling and John A. Roebling of the John A. Roebling Sons' Company, of Trenton, N. J., all graduates of the Institute who are famous as the builders of the Brooklyn Bridge.

(Continued from page 25.)

the patent office at Washington to protect the transmitter.

Dr. Steinmetz said last month:

"Theoretically, this is an interesting speculation, but whether it could ever become a possibility would depend on the question, whether a radio wave of such length could be found as to make the losses of power by absorption, etc., economically permissible, and whether stations for such wave length and power would be economically feasible. Furthermore, it would have to be an international development. Therefore, even if such radio transmission by a stationary electromagnetic wave sheet were possible, its realization at best is rather distant, so that the present outlook for radio power transmission is very remote."

Further details of the San Francisco experiments will be published in the November number of Radio Age.

Entertainment for Campers

Motorboating has always been popular at camps along water fronts, but this year the summer colony at Oakmont, Pa., where all Pittsburghers find relief from the hot offices and streets, had an added feature—radio. Here the Allegheny River affords an opportunity for this rare treat. KDKA, at the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., less than ten miles away, furnishes the entertainment.

One camp, fortunate enough to possess a motor boat, has it equipped with a loop antenna, and almost any time during the afternoon and evening baseball scores, latest news, market reports, and good music is heard while motoring up and down the river.

Another antenna is erected at the camp so that the Aeriola, Sr., is sometimes taken down to the beach, where, during the lazy afternoons and evenings, the girls listen in on the Fashion Talks and other features of particular interest to them.

Send $1.00 to Radio Age, 64 Randolph Street, Chicago, and receive this middle-west radio periodical for six months. Regular subscription price is $2.50 a year. Thus you will be getting two months free.

Wires Join Wireless

Announcement has been made by Edward J. Nally, President of the Radio Corporation of America, that an agreement had been signed between his company and the Postal Telegraph-Cable Company whereby every office of the Postal Company in the United States becomes an agency of the Radio Corporation for the acceptance of radiograms for transmission across the Atlantic Ocean and for the delivery of radiograms received from overseas for points in the United States.

This important linking up of radio and wire line services reflects the rapid growth of the Radio Corporation's overseas telegraph traffic since the return of its high power stations by the Government after the close of the World War.

These stations transmit and receive radiograms directly to and from England, France, Norway and Germany, and through connecting stations abroad, to and from all countries in Europe, Asia and Africa.

The Radio Corporation now maintains the only direct line of telegraph communication with Gèrmany and Scandinavia; and additional direct service is planned for the near future with Belgium, Holland, Italy, Poland and Sweden, giving to those peoples the opportunity to communicate directly with their scattered brethren and nationals in all sections of the country.

Prior to the arrangement made by the Radio Corporation of America whereby it is enabled to use the extensive land line service of the Postal Telegraph Company, practically all of the radiograms transmitted to transatlantic countries originated in New York City and Washington, D. C. The contract just signed gives to the inland commercial centers and the thousands of small points reached by the postal system equal facilities with those now enjoyed by the eastern cities mentioned, the Postal Telegraph Company performing the same service for radiograms of the Radio Corporation of America as it does for cablegrams to be transmitted by submarine cable.

Mr. Nally pointed out that although heretofore radiograms received from Europe, destined to points inland in the United States, had been forwarded over telegraph land lines, the complimentary service established by the agreement with the Postal Company insures prompt organized collection as well as distribution of radiograms at all points in the United States and gives to every section of the country the benefits of the phenomenal advances made in recent years in the radio art.

With the coming development of high speed wireless telegraphy the new arrangement will permit the Radio Corporation of America to carry out its plans for the inauguration of a low rate plain language radio letter service to and from all points in the United States and Europe, thus contributing largely to the establishment of closer and more friendly relations between the peoples of both lands.

The Radio Corporation's present offices in New York, Washington and San Francisco for the reception and delivery of radiograms will be continued, and its plans for the opening of additional offices of its own in the more important centers from time to time will go forward as the growth of business warrants.

It will be remembered that the Radio Corporation of America is the outgrowth of the Marconi Wireless Telegraph Company of America, and was formed after the close of the war in response to the appeal of Government representatives and to the national desire for an American owned, controlled and operated radio Communication company on a scale equal to the task of developing the new art and making it of the greatest possible service to the American people and the American government.

Radiograms coming over the land wires of the Postal Telegraph system from all sections of the country will be received at the Central Radio office at 64 Broad Street, where all the Eastern radio stations of the corporation are controlled. So far has automatism been carried in this new art that a bit of perforated paper tape in Broad Street sends a message to Europe without the aid of human hands, and, at the other end, another bit of tape likewise without prompting by human operators takes the message out of the air and visualizes it for the operator with a wavering line of blue ink.

Radio as a Profession

Much has been read and written in regard to the question: What does Radio offer as profession to the ambitious young man of today?

Although this is a relatively broad subject, still the question can be answered in a few words. The only factors that limit the heights to which a man can climb in Radio, are his pep or enthusiasm, and his knowledge of the subject.

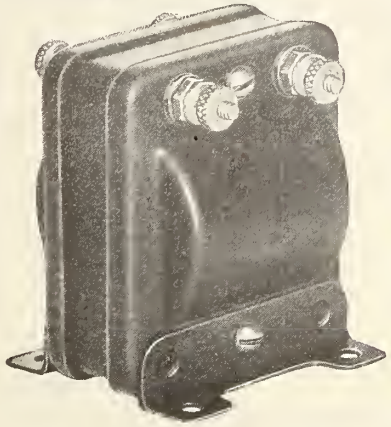
If we recall the early days of the telephone and automobile industries, we will remember that similar questions were asked at that time. But is there any more need now of asking what opportunities these industries offer? Large and small fortunes have been reaped by the men who had the foresight to get started early and grow up as the industries developed.

Radio, however, is moving faster and outstripping them all. It is difficult to predict exactly what the future of Radio will be, but that we can prepare ourselves for some remarkable achievements is the warning given by the large number of enthusiasts who are now busily engaged in furthering its progress.

It was said that knowledge of the subject is one of the two prerequisites a man must have in order to attain big success in Radio. But where is the man to obtain this valuable knowledge? It is true that Radio is now being taught in many of the schools of the country; but these schools are generally located in the larger cities, and hence are accessible to only a very small percentage of the large number of men and boys who are

(Continued on page 28.)

"United" Radio Products

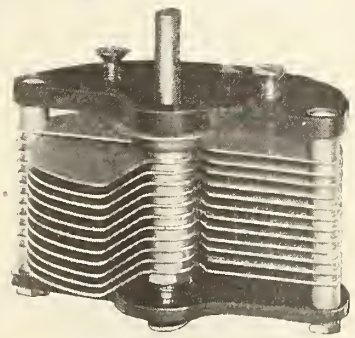


Two finishes: Black Enamel or Buffed Nickel Plated.....$4.50

"United" Audio Frequency Transformers

The beauty of the outside of this transformer is but a reflection of the superb workmanship under the shell—no howling—no distortion—clear amplification for one or more stages.

"United" Variable Condensers



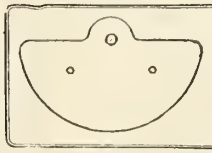
Prices

43 plate	**$4.50**
23 plate	**4.00**
11 plate	**3.50**
5 plate	**2.75**
3 plate	**2.25**

without dial or knob

That "United" Condensers have become the standard with manufacturers of radio sets, by which all others are judged, is, in itself, the strongest endorsement of their superior construction and effectiveness.

Ask your dealer to show you this condenser —then you, too, will appreciate why it has been accepted as the standard.



Mounting made easy by our template for locating panel holes; free with each condenser.

NOTE

Any advertised claim of having an arrangement with us to sell our products at special prices, is fraudulent.

United Mfg. & Distributing Co.
536 Lake Shore Drive, Chicago.

(Continued from page 27.)

anxious to learn more about this most fascinating subject. How, then, can this larger number be served?

Here is where the Radio correspondence school plays its role. With the correspondence school the mailman brings the school to the home instead of the man having to go to the school. Having his lessons with him all of the time, the ambitious learner can devote all spare moments of the day toward acquiring the desired knowledge. With the improved methods of instruction, the modern correspondence school is now considered as efficient as the resident school.

As an effective correspondence school in modern and commercial Radio, we can cite the American Electrical Association, located at 4513 Ravenswood Ave., Chicago, Illinois. Mr. Arthur G. Mohaupt, who is director of the school, is a college trained engineer with a broad experience in the engineering and teaching professions. He gives all his students his personal attention, and in this way succeeds in making the home instruction practically as effective as actual class room instruction. Mr. Mohaupt will gladly answer any questions that our readers may have in regard to the course or his methods.

Die Cast Wood Horn

(From the American Art Mache Company.)

Our Madera Horn is manufactured by breaking down selected wood to its original fibre, then compressed with 12 tons of pressure and 800 degrees of heat which produces a wood that is much more compact than the original state in which it grows.

Our horns and cabinets have been tested by the engineers of all of the leading radio concerns in the U. S. Through these tests we have gained positive conclusions that the principle of our horn is correct and that horns made of metal are not logical for clear tones. They come fitted with attachments for half head sets or single receivers. We can furnish the horns without base fitted with attachment for any loud speaker if you will give us the name; cabinet cannot be used for this purpose.

We have spent considerable time and money to perfect this item and judging by the replies received from users, dealers, jobbers and manufacturers, we know that our effort has met with success

Club Notes

On Thursday, September 21, the the Radio Club of Illinois entertained the radio fans of Chicago. Many enthusiastic amateurs took advantage of the invitation extended by the Secretary, John P. Tansey, and from noon until midnight, the crowds kept coming. They were entertained by talks given by Opie Read, the well-known journalist and lecturer; Alderman Anton J. Cermak, Chairman of the Committee on Compensation; Alderman George Maypole; Lucius J. L. Malmin, United States Judge of the Virgin Isles; U. J. Herrmann; and A. H. Kopprasch.

Paul B. Coats gave a demonstration of the Armstrong super-regenerative receiving set. The Radio Club of Illinois is located at 16 East Ontario Street, where many entertainments of this kind take place and where visitors are welcome.

Lane Radio Club

The first meeting of the Lane Radio Club was held on Monday, September 11, at which new officers were elected for the coming year, and future plans discussed. The membership is comprised of students and instructors in Lane Technical High School.

NEW BROADCASTING STATIONS

ABBREVIATIONS

The necessary corrections to the List of Radio Stations of the United States and to the International List of Radiotelegraph Stations, appearing in this Bulletin under the heading "Alterations and corrections," are published after the stations affected in the following order:

Name = Name of station.
Loc. = Geographical location: O = west longitude, N = north latitude, S = south latitude.

(Continued on next page.)

ANNOUNCEMENT

Subscribers to THE NATIONAL RADIO MAGAZINE are notified that with this issue RADIO AGE discontinues distribution to such subscribers. Although under no obligation to do so, having no connection whatever with THE NATIONAL RADIO MAGAZINE, we volunteered to send our magazine to National subscribers up to and including October.

If you like RADIO AGE you will want to continue receiving it. We make you this *special offer*. Sign and return the blank below and receive RADIO AGE for six months for only $1 or send $1.50 and receive this leading mid-west radio periodical for TWELVE MONTHS. Cut out the coupon and send TODAY.

This Coupon and $1

Cut this out and send to Radio Age, 64 West Randolph Street, Chicago, Ill., and receive this magazine for six months. The regular subscription price is $2.50 per year.

RADIO AGE,

64 West Randolph Street, Chicago.

Enclosed find $1 for which please send me Radio Age for six months.

Name .....

Street No. .....

City .....

State .....

With Pleasure

We are glad to publish the following letter and would like to hear from any others who have something to say about their radio activities:

To The Editor:

In your September issue of Radio Age we noticed a list of companies featuring free radio concerts at their place of business. It is our desire to inform you and the public that we also offer that service at our store at 6845 Stony Island Avenue. Accommodations have been provided so that people interested in radio may be comfortably seated at any time of day to listen to, inspect or inquire about radio.

MIDLAND RADIO CO., Chicago,

(R. O. Ogden.)

(Continued from page 28.)

Call = Call letters assigned.
System = Radio system used and sparks per second.
Range = Normal range in nautical miles.
W. l. = Wave lengths assigned: Normal wave lengths in italics.
Service = Nature of service maintained:
PG = General public.
PR = Limited public.
RC = Radio compass station.
P = Private.
O = Government business exclusively.
Hours = Hours of operation.
N = Continuous service.
X = No regular hours.
m = a. m. (12m = midday).
s = p. m. (12s = midnight).
Rates = Ship or coast charges in cents: c = cents. (The rates in the international list are given in francs and centimes.)
I. W. T. Co. = Independent Wireless Telegraph Co.
R. C. A. = Radio Corporation of America.
S. O. R. S. = Ship Owners' Radio Service.
C. w. = Continuous wave.
I. c. w. = Interrupted continuous wave.
V. t. = Vacuum tube.
FX. = Fixed station.

Alphabetically by names of cities.

[Additions to the List of Radio Stations of the United States, Radio Service Bulletin, edition June 30, 1922.]

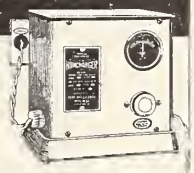
City.	Call signal.	City.	Call signal.
Allentown, Pa.	WIAN	Neenah, Wis.	WIAJ
Atlantic City, N. J.	WHAR	Norfolk, Nebr.	WJAG
Binghamton, N. Y.	WIAV	New Orleans, La.	WIAF
Birmingham, Ala.	WIAG	Newton, Iowa	WIAH
Bluefield, W. Va.	WHAJ	Norwood, Ohio	WIAL
Boise, Idaho	KFAU	Ocean City, N. J.	WIAD
Burlington, Iowa	WIAS	Omaha, Nebr.	WIAK
Butte, Mont.	KFAP	Paducah, Ky.	WIAR
Butte, Mont.	KFBF	Portland, Me.	WJAL
Cedar Rapids, Iowa	WJAM	Reno, Nev.	KFAS
Cedar Rapids, Iowa	WKAA	Rockford, Ill.	WIAB
Cincinnati, Ohio	WHAG	Rockford, Ill.	WJAH
Clarksburg, W. Va.	WHAK	Rochester, N. Y.	WHAM
Cleveland, Ohio	KDPM	Saginaw, Mich.	WIAW
Corinth, Miss.	WHAU	San Antonio, Tex.	WJAE
Davenport, Iowa	WHAI	San Diego, Calif.	KFBC
Dayton, Ohio	WJAJ	San Jose, Calif.	KFAQ
Decatur, Ill.	WHAP	San Luis Obispo, Calif.	KFBE
Eugene, Oreg.	KFAT	Santa Ana, Calif.	KFAW
Galveston, Tex.	WIAC	Savannah, Ga.	WHAO
Hanford, Calif.	KFBD	Seattle, Wash.	KDZT
Havre, Mont.	KFBB	Springfield, Mass.	WIAP
Hollywood, Calif.	KFAR	Springfield, Mo.	WIAI
Holyoke, Mass.	WHAX	Stockdale, Ohio	WJAK
Huntington, Ind.	WHAY	Tacoma, Wash.	KFBG
Joplin, Mo.	WHAH	Tampa, Fla.	WHAW
Joplin, Mo.	WJAC	Tarkio, Mo.	WIAT
Lansing, Mich.	WHAL	Troy, N. Y.	WHAZ
Le Mars, Iowa	WIAU	Venice, Calif.	KFAV
Lewiston, Idaho	KFBA	Vinton, Iowa	WIAE
Lincoln, Nebr.	WIAX	Waco, Tex.	WJAD
Lincoln, Nebr.	WJAB	Washington, D. C.	WHAQ
Lincoln, Nebr.	WKAC	Washington, D. C.	WIAY
Louisville, Ky.	WHAS	Waupaca, Wis.	WIAA
Marion, Ind.	WIAQ	Wichita, Kans.	WHAN
Milwaukee, Wis.	WIAO	Wichita Falls, Tex.	WKAF
Moscow, Idaho	KFAN	Wilmington, Del.	WHAV
Muncie, Ind.	WJAF	Yale, Okla.	WHAT

List of stations broadcasting market or weather reports (485 meters) and music, concerts, lectures, etc. (360 meters), alphabetically by call letters.

[Additions to the List of Radio Stations of the United States, Radio Service Bulletin, edition June 30, 1922.]

Call signal.	Station operated and controlled by—	Location of station.	Wave lengths.
KDPM	Westinghouse Electric & Mfg. Co.	Cleveland, Ohio	360
KDZT	Seattle Radio Association	Seattle, Wash.	360
KFAN	The Electric Shop	Moscow, Idaho	360
KFAP	Standard Publishing Co.	Butte, Mont.	360
KFAQ	City of San Jose	San Jose, Calif.	360
KFAR	Studio Lighting Service Co. (O. K. Olesen)	Hollywood, Calif., 1645 Hudson Avenue	360
KFAS	Reno Motor Supply Co.	Reno, Nev.	360
KFAT	S. T. Donohue	Eugene, Ore., 681 Willamette Street	360
KFAU	Boise High School, independent school district of Boise City.	Boise, Idaho	360, 485
KFAV	Cooke & Chapman	Venice, Calif.	360
KFAW	The Radio Den	Santa Ana, Calif.	360
KFBA	Ramey & Bryant Radio Co.	Lewiston, Idaho	360
KFBB	F. A. Buttrey & Co.	Havre, Mont.	360
KFBC	W. K. Azbill	San Diego, Calif., 5038 Cliff Place	360
KFBD	Clarence V. Welch	Hanford, Calif., 315 North Douty Street	360
KFBE	Reuhen H. Horn	San Luis Obispo, Calif.	360
KFBF	Butte School of Telegraph (F. H. Smith)	Butte, Mont.	360
KFBG	First Presbyterian Church	Tacoma, Wash.	360
WHAG	University of Cincinnati	Cincinnati, Ohio	360

HOMCHARGE
YOUR RADIO BATTERY
for a Nickel



ENJOYABLE Radio Concerts and Maximum Receiving Range are obtained only when your battery is fully charged.

THE RADIO HOMCHARGER DE LUXE

charges your "A" or "B" battery over night. Silent and clean in operation—requires no watching—may be used right in your living room.

Connects to any lamp socket. Self-polarizing—fully automatic—cannot overcharge or injure the battery.

Entirely enclosed—approved by Underwriters. Unconditionally GUARANTEED. Lasts a lifetime.

Beautifully finished in Mahogany and Gold—the most efficient and handsome rectifier ever produced. Sold by all dealers, $18.50 complete. Send for Bulletin 637. IT'S FREE.

THE AUTOMATIC ELECTRICAL DEVICES CO.
146 West Third Street
Cincinnati, Ohio

Over 50,000 HOMCHARGERS in Use

Western Electric
Vacuum Tubes
For the Armstrong Super-Regenerative circuit. Supply limited.

VT2 Transmission and Power Amplifier..... $12.00
VT1 Detector and Amplifier..... $8.00

Dealers Write for Discounts

RADIO SPECIALTY CO.
29 So. LaSalle St. Chicago, Ill.

The Clifton Detector
No Catwhiskers
Crystals and contact points sealed in Containers.
Is simple to operate.
No replacements necessary.
First cost—last cost.
If Your Dealer Cannot Supply You write us.
$1.50 Postpaid
The Clifton Manufacturing Co.
Newark, N. J.

RADIO MAILING LISTS
9270 Retail Radio Dealers.....price per M. $ 7.50
1104 Radio Manufacturers.....price per List 10.00
1330 Radio Supply Jobbers.....price per List 12.50
267 Assemblers & Mfgrs. of complete sets.....price per List 4.00
260 Radio Stations.....price per List 4.00
14000 Radio Amateurs & Managers of Radio Stations.....price per M 7.50
Typewritten and ready to send on receipt of remittance.
TRADE CIRCULAR ADDRESSING CO.
166 W. Adams St., Chicago, Ill.

How to Make an Audio Frequency Amplifying Transformer

(Continued from page 12.)

so that the brass clamps which are to hold the core together will come up flush. If this has been correctly finished, it will look like the drawing, Figure 9.

Care should be taken, when the core iron is being placed inside the tube, to see that the wires of the coil come out on the proper sides. The two wires of the inside coil should come out on one side (the flat side) of the core, and the ends of the other coil should come out on the other side as shown in Figure 14. Next make the brass clamps, which hold the transformer together. To do this, cut out two pieces of brass one-sixteenth of an inch thick, in the shape and size shown in Figure 10. These are to be placed on each side of the finished core, to hold it together. Cut out the large square hole in the center by drilling holes close together around the edge and then cutting the whole piece out with a cold-chisel, and finally dressing it to size with a file. The holes, through which the screws are to be placed, are drilled with a Number 18 drill. The flanges should be turned over at the bottom to make the feet on which the transformer is to stand. As these flanges are to serve as a mounting on a panel or base, they should also be drilled to allow screws to pass through and fasten them down.

Two pieces of hard rubber, or fiber, one-eighth inches thick, are next to be cut out as shown in Figure 11. These are used for the purpose of mounting the binding posts, to which the terminals of the coil are connected, when the transformer is completed. The location and size of these holes are plainly shown in the drawing. Next, four brass bushings of the size shown in Figure 12 are made. This can be done by cutting off four pieces of brass tubing one-fourth of an inch in length, and having a hole through the center, large enough to accommodate the 8-32 screws which are to be used for holding the transformer together.

These brass bushings are placed under the hard rubber strips to set them out one-fourth of an inch, to prevent the screws of the binding posts coming in contact with the metal parts of the transformer. Now, from a piece of thin brass, cut out four small connectors as shown in Figure 13. These need not be more than one-thirty-second of an inch thick, and are to be placed under the screws of the binding posts to allow for soldering the terminals of the coil as shown in Figure 14.

(Continued on page 31.)

WHAH	John T. Griffin	Joplin, Mo., 112 West Sixth Street	360
WHAI	Radio Equipment & Mfg. Co.	Davenport, Iowa	360
WHAJ	Bluefield Daily Telegraph and E. K. Kitts	Bluefield, W. Va.	360
WHAK	Roberts Hardware Co.	Clarksburg, W. Va.	360
WHAL	Phillips Jeffery & Derby	Lansing, Mich.	360
WHAM	University of Rochester	Rochester, N. Y.	360
WHAN	Southwestern Radio Co.	Wichita, Kans.	360
WHAO	Frederic A. Hill	Savannah, Ga.	360
WHAP	Dewey L. Otta	Decatur, Ill., 659 West Eldorado Street	360
WHAQ	Semmes Motor Co.	Washington, D. C.	360
WHAR	Paramount Radio & Electric Co.	Atlantic City, N. J.	360
WHAS	Courier-Journal and Louisville Times	Louisville, Ky.	360, 485
WHAT	Yale Democrat-Yale Telephone Co.	Yale, Okla.	360
WHAU	Corinth Radio Supply Co.	Corinth, Miss.	360
WHAV	Wilmington Electrical Specialty Co.	Wilmington, Del.	360
WHAW	Pierce Electrical Co.	Tampa, Fla.	360
WHAX	Holyoke Street Ry. Co.	Holyoke, Mass.	360
WHAY	Huntington Press	Huntington, Ind.	360, 485
WHAZ	Rensselaer Polytechnic Institute	Troy, N. Y.	360
WIAA	Waupaca Civic and Commerce Association	Waupaca, Wis.	360
WIAB	Joslyn Automobile Co.	Rockford, Ill.	360
WIAC	Galveston Tribune	Galveston, Texas	360
WIAD	Ocean City Yacht Club	Ocean City, N. J.	360
WIAE	Mrs. Robert E. Zimmerman	Vinton, Iowa	360
WIAF	Gustav A. De Cortin	New Orleans, La., 139 North Alexander Street.	360
WIAG	Matthews Electrical Supply Co.	Birmingham, Ala.	360
WIAH	Continental Radio & Mfg. Co.	Newton, Iowa	360
WIAI	Heer Stores Co.	Springfield, Mo.	360
WIAJ	Fox River Valley Radio Supply Co.	Neenah, Wis.	360
WIAK	Journal-Stockman Co.	Omaha, Nebr.	360, 485
WIAL	Standard Service Co.	Norwood, Ohio	360
WIAN	Chronicle & News Publishing Co.	Allentown, Pa.	360
WIAO	School of Engineering of Milwaukee and Wisconsin News.	Milwaukee, Wis.	360
WIAP	Radio Development Corp.	Springfield, Mass.	360
WIAQ	Chronicle Publishing Co.	Marion, Ind.	360
WIAR	J. A. Rudy & Sons	Paducah, Ky.	360
WIAS	Burlington Hawkeye & Home Electric Co.	Burlington, Iowa	360
WIAT	Leon T. Noel	Tarkio, Mo.	360
WIAU	American Trust and Savings Bank	Le Mars, Iowa	360
WIAV	New York Radio Laboratories	Binghamton, N. Y.	360
WIAW	Saginaw Radio & Electric Co.	Saginaw, Mich.	360
WIAX	Capitol Radio Co. (Paul C. Rohwer)	Lincoln, Nebr.	360
WIAY	Woodward & Lothrop	Washington, D. C.	360
WJAB	American Radio Co.	Lincoln, Nebr.	360
WJAC	Redell Co.	Joplin, Mo.	360
WJAD	Jackson's Radio Engineering Laboratories	Waco, Texas	360
WJAE	Texas Radio Syndicate	San Antonio, Texas	360
WJAF	Munsey Press	Munsey, Ind.	360
WJAG	Norfolk Daily News (Huse Publishing Co.)	Norfolk, Nebr.	360
WJAH	Central Park Amusement Co.	Rockford, Ill.	360
WJAJ	Y. M. C. A.	Dayton, Ohio	360
WJAK	White Radio Laboratory	Stockdale, Ohio	360
WJAL	Victor Radio Corp.	Portland, Me.	360
WJAM	D. M. Perham	Cedar Rapids, Iowa	360
WKAA	Republican Times and H. F. Paar	Cedar Rapids, Iowa	360
WKAC	Star Publishing Co.	Lincoln, Nebr.	360
WKAF	W. S. Radio Supply Co.	Wichita Falls, Texas	360

Commercial land stations.

[Additions to the List of Radio Stations of the United States, edition of June 30, 1922, and to the International List of Radiotelegraph Stations published by the Berne bureau.]

Station.	Call signal.	Wave lengths.	Service.	Hours.	Station controlled by—
Chicago, Ill.[1]	WQX	140	PR(FX)	X	Walter A. Kuehl.
Kanatak, Alaska[2]	KGC	300, 525, *600*, 1625	PR(FX)	X	Associated Oil Co.
Pittsburgh, Pa.[3]	KQV	*200*, 425	PR(FX)	X	Doubleday-Hill Electric Co.
Port Townsend, Wash.[4]	KRP	300, *600*	PG		Port Townsend Radio Co.

[1] Loc. (approximately) 0.87° 37′ 00″, N. 41° 53′ 00″; range, 50; rates, none.
[2] Loc. (approximately) 0.157° 39′ 30″, N. 57 42′ 00″; range, 300; system, Kilbourne & Clark, 1000; rates, none.
[3] Loc. (approximately) 0.80° 20′ 00″, N. 40° 20′ 00″; range, 200; system, composite, v. t., telephone, and telegraph; rates, none.
[4] Loc. 0.122° 46′ 02″, N. 48° 07′ 01″; range, 300; system, composite, 250; hours, 12 noon to 11 p. m.; rates, ship service, 6 c. per word.

Alphabetically by call signals.

[b = ship station; c = land station.]

Call signal.	Name.	Call signal.	Name.
KGC	Kanatak, Alaska....c	KRP	Port Townsend, Wash....c
KQV	Pittsburgh, Pa....c	WQX	Chicago, Ill....c

Government land stations, alphabetically by names of stations.

[Additions to the List of Radio Stations of the United States, edition of June 30, 1922, and to the International List of Radiotelegraph Stations published by the Berne bureau.]

Station.	Call signal.	Wave lengths.	Service.	Hours	Station controlled by—
Bethel, Alaska	WVI				U. S. Army.
Jupiter, Fla. (RC)[1]	NAQ	800	RC	X	U. S. Navy.
Selfridge Field, Mich. (Mount Clemens).	WVAO				U. S. Army.

[1] Loc. 0.80° 04′ 57″, N. 26° 56′ 59″; range, 150; system, U. S. Navy.

(Continued on page 32.)

Radio Corporation Election

Edward J. Nally, president of the Radio Corporation of America, announces that at a meeting of the Board of Directors of the Radio Corporation of America, held September 8, Mr. Sarnoff was elected Vice President and General Manager of this corporation.

Mr. Sarnoff is probably one of America's youngest executives, being only thirty-two years old. He has been associated with radio for more than sixteen years, and with the Radio Corporation of America since its organization. An early exponent of the modern radio broadcasting idea, Mr. Sarnoff is today considered one of the foremost workers of the radio industry. His activities have been marked by ever increasing achievements as an executive of unusual ability.

At this same meeting, Mr. William Brown was elected to the office of Vice President and General Attorney. Mr. Brown has been connected with the Radio Corporation of America for a number of years, during which time he has handled many of the important legal matters that have been incidental to rapid growth of this organization.

Mr. Nally, who sailed for Europe on September 9, on the Homeric, while abroad will visit England, France, Germany, Holland, Norway, Poland and Sweden.

Mr. Nally states that his company recently concluded contracts with the governments of Poland and Sweden for the building of high-power radio stations to be used for direct duplex radio telegraph service between these countries and the United States, thus adding two additional radio circuits to the five already in successful operation between the United States and foreign countries.

The transocean telegraph traffic of the Radio Corporation, Mr. Nally states, is growing at a very gratifying rate. The world-wide recognition being accorded noteworthy scientific and commercial radio developments in the United States is giving to America a larger sphere in the affairs of international communication.

Send $1.00 to Radio Age, 64 Randolph Street, Chicago, and receive this middle-west radio periodical for six months.

For reliable and up-to-date information on radio read

RADIO AGE

For prompt and efficient service place your order with representatives of the Periodical Sales Co., whose authority and responsibility is assured by credentials in their possession bearing the registered trade-mark of the Periodical Sales Co., facsimile of which is reproduced hereon.

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HUNDREDS U. S. GOVERNMENT POSITIONS continually open to men—women over 17. $92–$190 month. Quick, steady raise. Paid vacation. No strikes. Steady work. Short hours. Common education sufficient. "Pull" unnecessary. Write immediately for list positions. Franklin Institute, Dept. J 117, Rochester, N. Y.

PUBLICATIONS.

RADIO MANUAL, everything the beginner should know. How to build and operate an inexpensive receiving set. Sixty-four pages, thirty illustrations. Twenty cents. Postpaid. Raydio Publishing Company, Caxton Building, Cleveland, Ohio.

Announcement

Products will be ready for the trade about October 15th, 1922.

Discounts very attractive to jobbers and dealers.

Watch for our future advertisements.

RADIO PRODUCTS CORP. OF AMERICA
55 Broadway, New York

Edeson Radio Phones
Adustable Diaphragm Clearance

We guarantee satisfaction, or your money refunded. The adjustment feature places *our* phones on a par with the world's greatest makes. Our sales plan eliminates dealer's profits and losses from bad accounts, hence the low price. Better phones cannot be made. Immediate deliveries. Double 3000 Ohm sets, $3.98; 1500 Ohm single set, $2.50. Circular free.

Edeson Phone Co. 6 Beach St., Dept 7 Boston Mass

How to Make an Audio Frequency Amplifying Transformer

(Continued from page 30.)

These binding posts may consist of plain brass machine screws and a nut. The connectors are mounted on the hard rubber pieces before the transformer is assembled.

To assemble the transformer, the top screws are first put through the holes in the hard rubber piece on one side, then a bushing placed on each of the screws, then the screws are put through the holes in the frame on one side and then through the frame on the other side. The other two bushings are next slipped over the screws and the other hard rubber terminal strip is placed in position and the whole is fastened together. The screws should not be drawn up too tight, as this might bend the frame out of shape, but it should be held together fairly tight. The finished transformer is shown in Figure 14.

WIRELESS

New License Quiz Book
FOR
APPLICANT
TO
United States Government
New Rating of
Radio Operator's License Examinations

This is the first edition printed with the new rules, regulations and gradings laid down by the government. It gives a full description of various hook-ups, new devices, practical equations, international law and regulations, official gradings, diagrams, definitions and other important information.

No amateur or wireless professional can afford to be without this book.

107 pp. *80 Illus.* *Price $1.00*

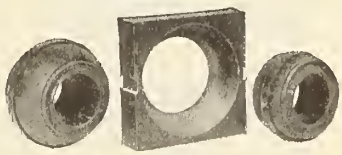
RADIO AGE
64 W. Randolph St. Chicago

3000 OHM SETS, $4.50
2000 OHM SETS, $4.00 1000 OHM SETS, $3.50
Plus 20c for Postage and Insurance.
Satisfaction Guaranteed or Money Back.

We mail phones the day your order arrives. Every pair tested, matched, and guaranteed as sensitive as $8 to $10 phones. We have no agents or dealers. By ordering direct you save dealer's profits—circular free.

TOWER MFG. CO., Brookline, Mass.
22 Station St.

Artistic Variometer Parts
Wholesale Only



Variocouplers,
Rotors, Winding Forms, Stators,
in Genuine Mahogany.
Quick Deliveries. Write for prices.

Artistic Wood Turning Works
517 No. Halsted Street, Chicago, Illinois

Send $1.00 to Radio Age, 64 Randolph Street, Chicago, and receive this middle-west radio periodical for six months. Regular subscription price is $2.50 a year. Thus you will be getting two months free.

Announcing

The Second
NATIONAL
RADIO
EXPOSITION

1st Regiment Armory
CHICAGO
JAN. 13 to 20
1923 (incl.)

to be conducted along the same successful lines as was the National Show held in Chicago last June.

January is the ideal month for perfect radio reception, also the time when inventories have been made thereby enabling dealers to buy with intelligence and safety.

WRITE TODAY
for Diagram

Second
National
Radio
Exposition

417 S. DEARBORN ST.
CHICAGO

(Continued from page 30.)

Special land stations, alphabetically by names of stations.

[Additions to the List of Radio Stations of the United States, edition of June 30, 1922.]

Station.	Call signal.	Wave lengths.	Station controlled by—
Birmingham, Ala.	5XAG	*200*, 375	Matthews Electrical Supply Co.
Butte, Mont.	7YP	*200*, 375	Butte College of Telegraphy (F. H. Smith).
Corvallis, Oreg.	7YJ	*200*, 375	Oregon Agricultural College, department of physics.
Fort Worth, Texas	5ZAH	*200*, 375	Fort Worth Record.
Do	5ZY	*200*, 375	Fort Worth Star Telegram.
Galesburg, Ill.	9XW	*200*, 250, 375	Lombard College.
Pittsburgh, Pa.	8XY	Variable	West Penn Power Co.
Portland, Oreg.	7XL	250-1650	Northwestern Electric Co.
Raleigh, N. C.	4YC	*200*, 375	North Carolina State College (electrical engineering department).
Reading, Pa.	3XAH	*200*	Donald B. Heilman, 54 South Sixth Street.
Tacoma, Wash.	7YO	*200*, 375	Tacoma City College.
Troy, N. Y.	2XAP	Variable	Rensselaer Polytechnic Institute.

Special land stations, grouped by districts.

Call signal.	District and station.	Call signal.	District and station.
2XAP	Second district Troy, N. Y.		Seventh district:
3XAH	Third district: Reading, Pa.	7XL	Portland, Oreg.
4YC	Fourth district: Raleigh, N. C.	7YJ	Corvallis, Oreg.
	Fifth district:	7YO	Tacoma, Wash.
5XAG	Birmingham, Ala.	7YP	Butte, Mont.
5ZAH	Fort Worth, Tex.	8XY	Eighth district: Pittsburgh, Pa.
5ZY	Do	9XW	Ninth district: Galesburg, Ill.

Alterations and Corrections

Broadcasting stations, by call signals.

[Alterations and corrections to be made to the List of Radio Stations of the United States, edition of June 30, 1922.]

KDN (San Francisco, Calif.).—Address Fairmont Hotel.
KQP (Hood River, Oreg.).—W. l., 360 only.
WAAW (Omaha, Nebr.).—W. l., 360, 485.
WBAJ (Toledo, Ohio).—W. l., 360, 485.
WBAV (Columbus, Ohio).—W. l., 360, 485.
WCAD (Canton, N. Y.).—Erroneously given in June Bulletin as Canton, Ohio.
WGV (New Orleans, La.).—W. l., 360, 485.
WSY (Birmingham, Ala.).—Hours, 2:30 p. m. except Sunday and 8 p. m. every day.

Special land stations, by names of stations.

[Alterations and corrections to be made to the List of Radio Stations of the United States, edition of June 30, 1922.]

ASHLAND, OHIO (8ZN).—Address 208 Claremont Avenue.
BOULDER, COLO. (9XAQ).—Station operated and controlled by University of Colorado (department of electrical engineering).
CAMBRIDGE, MASS. (1XO).—Address 11 Windsor Street.
CHICAGO, ILL. (9XG).—W. l., *200*, 375; address, 4601 North Central Park Avenue.
DENVER, COLO. (9ZAG).—Address 1124 South University Street.
HAMILTON, OHIO (8XAG).—W. l., *200*, 275, 375; address 325 North B Street.
KANSAS CITY, MO. (9XAB).—W. l., *200*, 500; station operated and controlled by Western Radio Co., 6 West Fourteenth Street.
KANSAS CITY, MO. (9XK).—Address 3525 Walnut Street.
LA CROSSE, WIS. (9ZY).—Address 241 South Seventeenth Street.
LANSING, MICH. (8XM).—Call signal erroneously given as 8ZF in June Bulletin.
LITTLE ROCK, ARK. (5ZL).—Address 1301 Welch Street.
LOS ANGELES, CALIF. (6XAQ).—Address 140 South Oxford Street.
MADISON, WIS. (9XM).—W. l., 375, variable; station operated and controlled by University of Wisconsin (department of physics).
MINNEAPOLIS, MINN. (9XI).—W. l., *200*, 375, 1100, 2000.
NAPA, CALIF. (6ZAD).—*Read* Sunnyvale, Calif., P. O. Box 391.
NEW ORLEANS, LA. (5XH).—Address of owner 131 State Street, Boston, Mass.
OAKLAND, CALIF. (6XAJ).—Address Hotel Oakland.
PARKESBURG, PA. (3XW).—W. l., 375, 2500, variable.
PHILADELPHIA, PA. (3XC).—W. l., 400, 425; address, 2046 Arch Street.
PHILADELPHIA, PA. (3XV).—W. l., *200*, 250, variable; address, 5847 Ellsworth Street.
PORT ARTHUR, TEX. (5XV).—W. l., *200*, 225, 250, variable; station operated and controlled by Louis W. Hatry, 2048 Fifth Street.
PORTLAND, OREG. (7ZB).—Address 555 East Forty-fourth Street North.
PORTLAND, OREG. (7ZT).—Address 967 Vernon Avenue.
SAN FRANCISCO, CALIF. (6XX).—Address 433 California Street.
SOUTH PASADENA, CALIF. (6XAS).—W. l., *200*, 260, variable.
URBANA, ILL. (9XJ).—W. l., 375, variable.
WASHINGTON, D. C. (3XZ).—W. l., 175, *200*, 260, 330; address, 542 Irving Street.

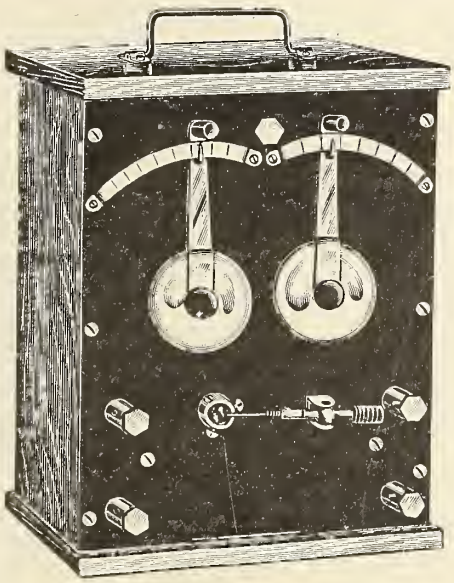
FREE—With Head Phones

Compact, High-Class Receiving Set

Looks Well and Performs Well

THIS instrument is assembled in a walnut cabinet with a highly polished Bakelite front, all metal parts highly nickeled.

The Crystal Detector is of the very latest pattern, with ball and socket arrangement, so same can be moved up and down, sidewise and forward and back so that the most sensitive point on the Galena can be located.



The Galena retainer is of standard size so that all mounted Galenas will fit it.

The size of the set is as follows: Height, 10 inches; width, 8 inches; depth, 6½ inches.

There are two tuning levers on the front. After locating the most sensitive point of the Galena the two levers are moved back and forth until the best result is obtained.

This receiving set WILL NOT receive messages from great distances but it works perfectly under favorable conditions from 15 to 25 miles away from the broadcasting station.

Each receiving set is guaranteed to be in perfect condition, being thoroughly tested before accepted from the factory.

You Can Get This Wonderful Radio Receiving Set

FREE

If you are willing to devote a little effort in telling your friends about RADIO AGE. It's as simple as A. B. C. Just write your name and address on the coupon below and we'll send you full particulars by first mail out.

RADIO AGE, Circulation Department
64 West Randolph Street, Chicago

Date.....

I am interested in securing one of your Radio receiving sets which you offer FREE. Please send me full particulars by return mail.

Name.....

Street.....

City..... State.....

Burgess, the *Radio* Battery
—construction fully patented

When you buy a Burgess "B" Battery you get more than long life, noiselessness, high capacity and moderate price. You get also Burgess special radio construction, perfected by wireless specialists and fully patented! This exclusive ***radio*** construction is found in no other battery on the market to-day.

What does this mean to users of radio batteries? It means clear receiving. It means lowest cost per hour of service. It means long shelf life and highest current capacity. It means that Burgess "B" Batteries are the best radio batteries it is possible to produce. Don't take our word for it—***ask any radio engineer.***

Leading manufacturers of radio equipment specify "Burgess." Burgess "B" Batteries are handled by all progressive jobbers and dealers. "Look for the Black and White Stripes." And if your dealer doesn't handle Burgess "B," just address:

BURGESS BATTERY COMPANY

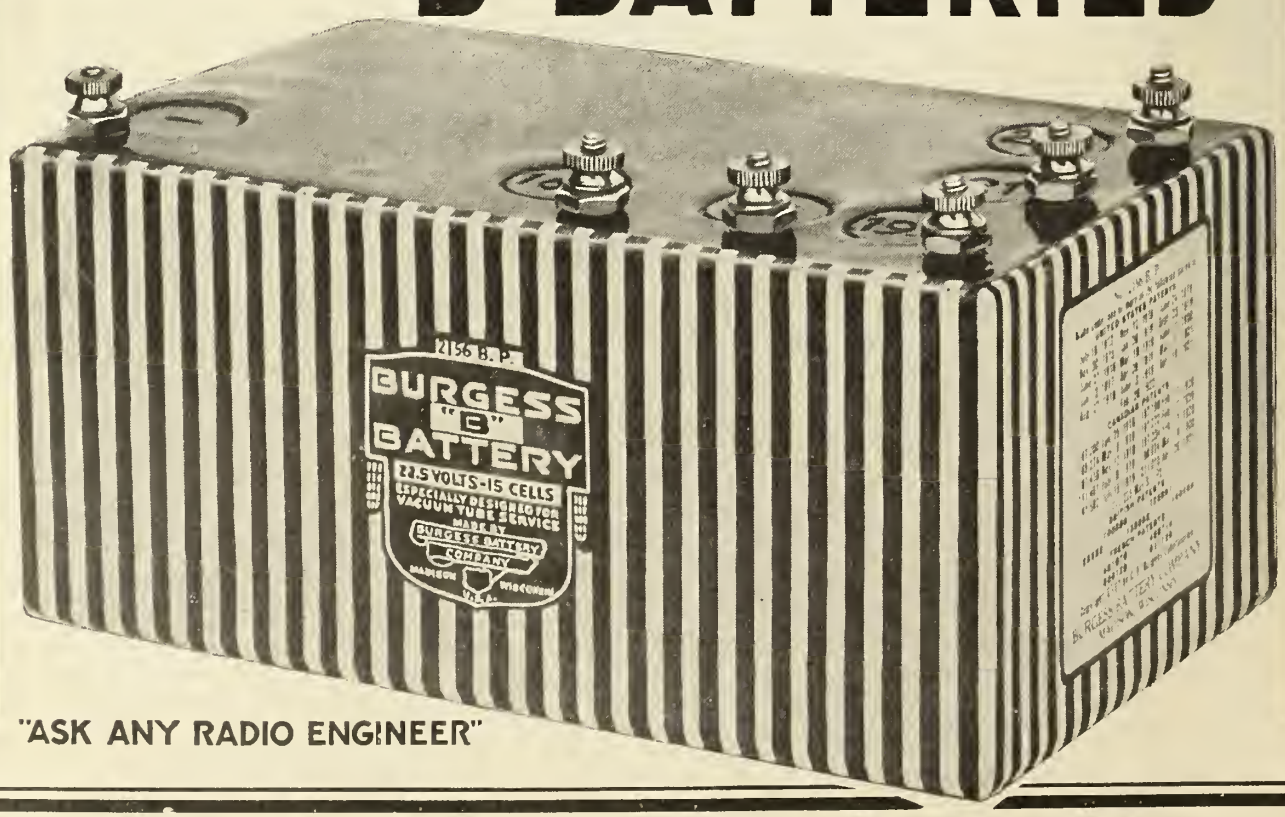
Engineers—Dry Batteries—Manufacturers

Offices and Warehouses at:

CHICAGO, ILL., 111 W. Monroe St. NEW YORK, N. Y., 50 Church St. BOSTON, MASS., 136 Federal St.
ST. PAUL, MINN., 2362 University Ave. KANSAS CITY, MO., 2109 Grand Ave. MADISON, WIS., Main and Brearly Sts.

In Canada: BURGESS BATTERIES, Ltd.
Winnipeg, Toronto, Montreal

BURGESS
"B" BATTERIES



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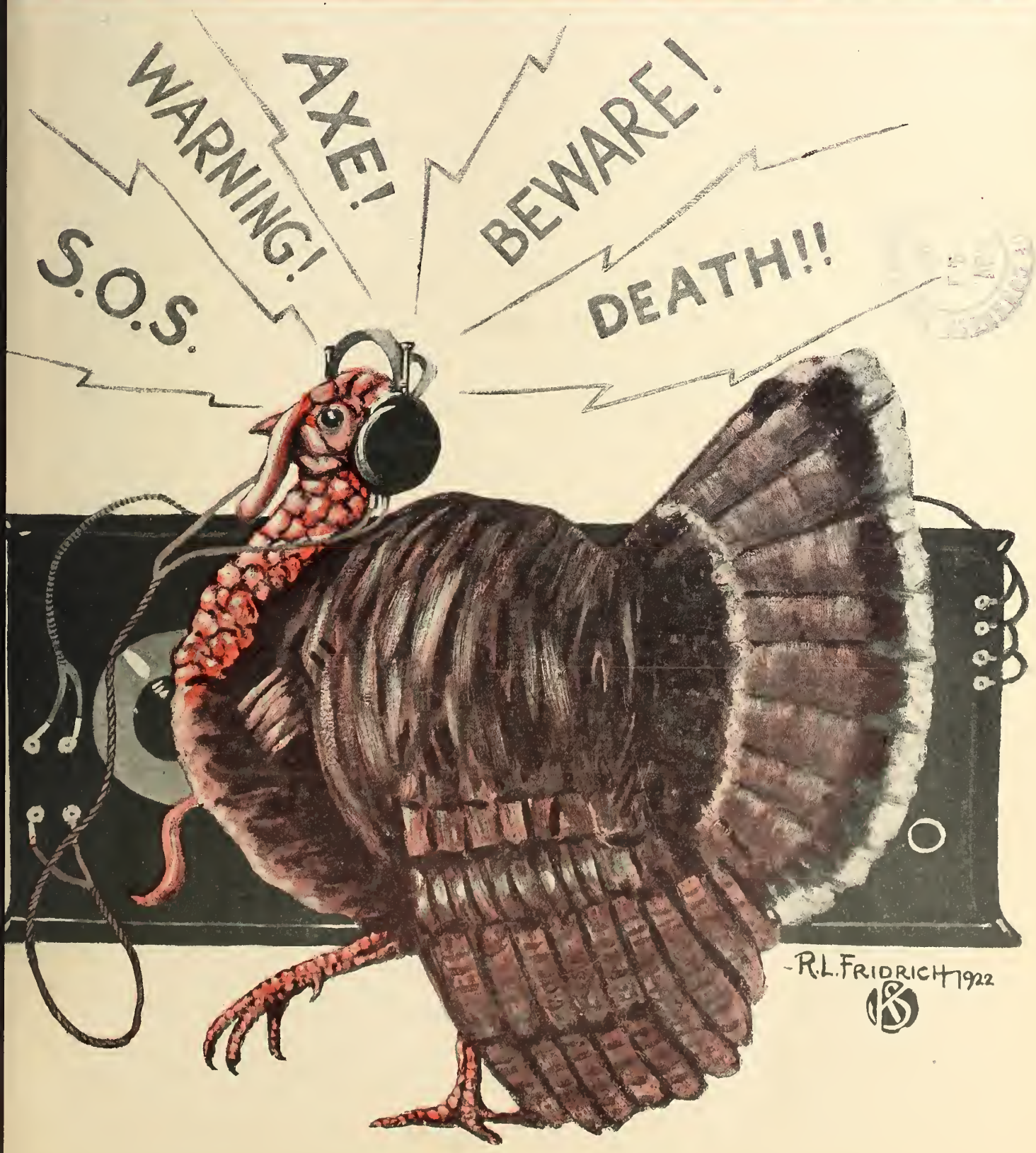
OUR BROADCASTING CRISIS—IN THIS NUMBER

RADIO AGE

The Magazine of the Hour

November, 1922 Price 25 cents



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RADIO AGE

The Magazine of the Hour

Volume 1 *Number 6*

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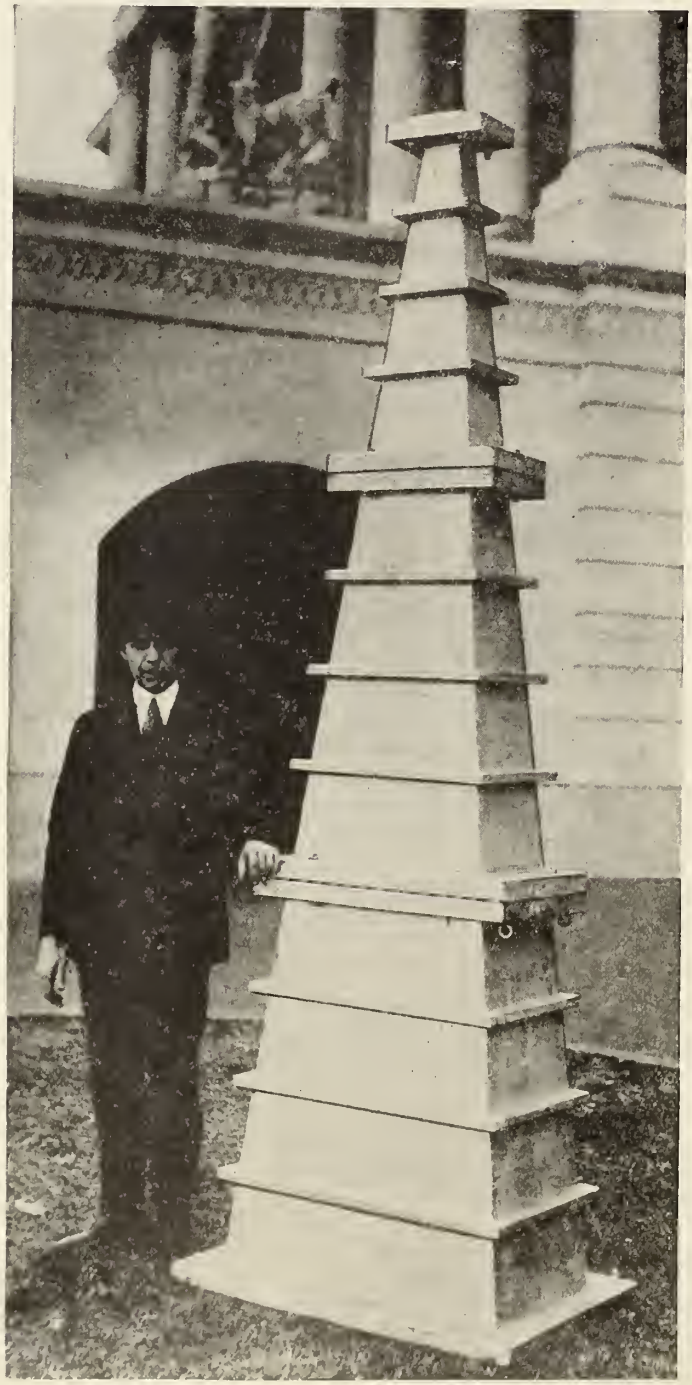
The Time Has Come to Stop Kidding Ourselves

WE ask broadcasters, owners of receiving sets, and manufacturers of radio equipment to give their earnest attention to the contents of this number of RADIO AGE. More than 500 broadcasting stations in the United States are beginning to wonder where and when they will get a return on their heavy investment. All these stations are confronted with the additional problem of interference in the air, in many localities this interference being persistent enough to practically nullify all efforts at transmission. Manufacturers of radio equipment are beginning to wonder where they will find a market for their goods if broadcasting becomes so disorganized that the fan will have no incentive to continue listening in.

This brings up the question as to the attitude and the rights of the hundreds of thousands of radio enthusiasts who have invested millions of dollars in radiophone receiving outfits. They bought their receiving sets on the presumption that satisfactory broadcasting was to be maintained.

Radio is on trial before the American public. Broadcasters have formed a National League and are preparing to meet the situation. Meanwhile needed legislation is tabled in Washington. Owners of stations are forced to consider the possibility that a monopoly will strive to take broadcasting service off their hands. Radio business has not come back as it was expected to do.

We are printing pages of news and views on this situation in this number of RADIO AGE. Every person, seriously interested in the advancement of Radio Art and of Radio Business should read every line of it.—The EDITOR.



Loud-speaking horn, used by city of Chicago in magnifying speeches and concerts at Pageant of Progress. Picture shows horn's size as compared with a man.
(By courtesy of Greater Chicago Magazine)

RADIO AGE
"The Magazine of the Hour"
M. B. SMITH, PUBLISHER
PUBLISHED MONTHLY GARRICK BLDG CHGO.
FREDERICK SMITH, EDITOR

Broadcasters Form National League

ORGANIZATION of the radio broadcasting interests of the country *for and by themselves* was accomplished in Chicago on October 16, when owners representing many of the more important stations assembled and launched the National Broadcasters' League. It is expected that the league eventually will include on its membership rolls practically all of the broadcasting station owners in the United States and Canada.

The purpose in organizing, as explained by speakers at the Chicago meeting, lies primarily in effecting a means of interchange of views and news between broadcasters. The general plan of the league might be condensed into the following outline:

1. To protect heavy investments owners of stations already have made and to find ways and means of obtaining some tangible return on that investment.

2. To establish a clearing house for information of value to all broadcasting station owners, so that they may be informed promptly of developments as to radio legislation; that they may work as a body for the elimination of interference in the broadcasting of programs; to improve programs; to present a united front against those persons and combinations of persons who are attempting to prey upon broadcasters; to convince the public and the government generally of the important position and strength of the broadcasting interests.

George S. Walker, President of the Western Radio Corporation, Denver, Colo., and owner of station KFAF, was elected president of the League. Arthur H. Ford, Professor of Electrical Engineering at the State University of Iowa, Iowa City, was made first vice-president. W. J. Baldwin, of the Alabama Power Company, Birmingham, Ala., was elected second vice-president, and Frederick A. Smith, of Radio Age, Inc., was chosen for secretary. Directors will include: Frank W. Elliott, WOC, Davenport, Iowa; T. B. Hatfield, Hatfield Electric Co., Station WOH; T. W. Findley, Minneapolis, Minn., StationWLAG, and owners of stations on the Atlantic and Pacific coasts and in the South.

It was decided to make the membership fee $10 a year, this nominal sum to be disbursed for postage, stationery and printing and distribution to all broadcasters of the periodical bulletins of importance to station owners. A complete view of the activities of the League will be published monthly in this magazine, which will give space for discussion of new problems by all or any members of the League who wish to thus communicate with their associates.

Executive offices of the League are located in the Garrick Building, Chicago, Ill., where communications from members or any others interested should be addressed.

From the outset the Chicago meeting made it apparent that broadcasters desired an association which should not be identified with any other radio organization. Co-operation, where cooperation was decided to be desirable, was generally agreed to be the purpose of the broadcasters. But the speakers were definite in their expressed opinion that the League should admit none but a broadcaster to membership and that it should not affiliate with any other radio group, whether manufacturers, tradesmen, or whatnot.

The meeting was called to order by Mr. Smith, who briefly explained that he had been asked by important broadcasting interests to bring about such a meeting. He said there were many problems confronting broadcasters at this time and that the interest in forming a union of station owners was evidenced by the large number of letters from station owners who could not be present but who wrote enthusiastic commendation of the plan and volunteered their services in making the organization a power for mutual progress and protection. Newspapers all over the country, having broadcasting stations in connection with their plants, were particularly quick to respond to the suggestion that a League was necessary.

Frank W. Elliott, member of the Iowa legislature, and vice president of the Palmer School of Chiropractic, at Davenport, Iowa, was made temporary chairman of the meeting. Mr. Elliott expressed the opinion that one of the most important subjects for discussion was that of interference.

T. B. Hatfield, of WOH, said:

"We are WOH of Indianapolis, Hatfield Electric Co. We have been broadcasting since March of this year. Our two problems are: First, Interference, on which something certainly must be done through an organization of this kind. I am here without any definite idea as to how the interference problem may be solved, but am eager to listen to whatever information we may get.

"Second: We are a commercial organization and it is costing us a pretty penny per month to run our broadcasting station, on which we get very little returns, unless advertising may count as such. But if we count advertising it is still costing us a great deal for that advertising. I am in favor of seeking some way of getting some return for our outlay. But primarily the thing to do is to find out how we can help each other to clean out the interference."

T. W. Findley, Station WLAG, Minneapolis, said:

"I bring to you a message from Prof. Jansky, of the University of Minnesota, who was one of the members of the Hoover committee which drafted the Kellogg-White bill. Here is Professor Jansky's letter, in part:

" 'Radio traffic is being regulated by the Department of Commerce, under the law of 1912. The Department is to a certain extent, handicapped by a lack of funds and personnel. To my mind the situation may best be remedied by early consideration of the Kellogg-White bill, which was prepared by the radio conference to give the Department of Commerce necessary authority to handle the present situation.

" 'The Department, under the present law, must proceed very slowly. The assignment of a wave band for broadcasting service in place of two single wave lengths will do much to prevent interference between stations. You can readily see that the allocation of wave lengths will be a very difficult one.' "

Mr. Findley went on to say that various men selected by Secretary Hoover to draft this bill spent a great deal of time on it. There has been opposition to the bills but Mr. Findley said Professor Jansky was convinced it was a step in the right direction.

It was suggested by the speaker that station owners broadcast a summary of the bill to their audiences and ask for expressions of opinion on the bill from the listeners. He urged that the users of receiving sets be enlisted in a move to induce congressmen to have the bill brought before the house without further delay. He said that some persons believed nothing could be accomplished until the senators got back to Washington but he disputed this, saying that the time to show the national legislators what was needed and what was wanted, was right now, so that when they returned to Washington they would be ready to act.

The bill referred to is the Kellogg-White radio bill, Senate Bill No. 3694. It was introduced April 20 and referred to a Senate committee on interstate commerce and to the House committee.

"This will slumber on the tables of the committee," said Mr. Findley, "unless the broadcasters get busy and bring about some action on it."

Ralph C. Watrous, former Governor of Rhode Island, representing the National Radio Chamber of Commerce, spoke next. Mr. Watrous explained that the Chamber was interested only in the common interest of all elements in the radio art. He said that only persons who would quarrel with the Chamber was one who had some selfish interest to promote. Mr. Watrous advised those present to get together for discussion and solution of the interference problem and other difficulties. He suggested a national conference. It was apparent that Mr. Watrous believed it would be best for the broadcasters to affiliate with the Chamber of Commerce, but when outspoken opposition to such a plan was expressed, he said that he hoped the League about to be formed would cooperate with the Chamber and that the Chamber would be glad to serve the broadcasters.

(Note—The Kellogg-White bill was published in full in the September issue of Radio Age.)

Radio Inspector E. A. Beane, of the Ninth District, next addressed the meeting on the subject of interference. As he is the air policeman for a territory covering an immense territory, his version of the interference situation was awaited with interest.

"It seems to me," he said, "that the only solution to local interference is the making of a definite program for each station and this can be done through organization. The plan I favor is to arrange a program of six days a week for each broadcasting locality. The seventh day would be called a "silent day" or "silent night" and on that night all broadcasting and local communications would cease, giving the listeners with the better class of equipment a chance to receive programs from a longer distance.

"The next night you would be in the air when some other location is silent and your broadcasting gets across. You can go to the amateur and say you are arranging a silent night to permit those with receiving outfits to listen in to outside concerts. If the amateurs will agree to stand by every night during your general broadcasting program from 7 to 10:30 o'clock you will stand by and give them a chance to send and receive long distance work.

"In Louisville we put such an arrangement through in a few hours' time. A committee was asked to take care of all complaints. I believe your organization should incorporate such a plan in your work. The public should be educated in the proper use of apparatus."

Thorne Donnelley, Station WD APF, Chicago, expressed the opinion that one national organization should assume the work outlined by the extra speakers. George Lewis, Secretary of the National Radio Chamber of Commerce, brought up the question of what rights, if any, owners of copyrights on music and songs had in the way of taxing broadcasters of such music and songs.

C. B. Cooper, secretary of the Broadcasters Society of America, told how that body of a few eastern broadcasters had found difficulty in eliminating interference in New York.

George S. Walker said:

"We are broadcasting out in Denver at a great expense. I am wondering where we are at. I have made a big investment and would hate to lose it. I went into it at the request of my boy who is 18 years old. I believe there should be an organization of broadcasters to protect our investment if nothing else. We do not know at what moment we will be wiped out, with our investment.

"We are told that we can broadcast expensive programs but where do we get our compensation? I have a radio store in Denver, but when we broadcast music for the entertainment of radio fans at great expense we expect to be repaid by the sale of radio goods. Yet the next morning we find that the soft drink parlor has put in a receiving set to permit patrons to listen to our programs and the soft drink parlor is selling radio sets.

"We should form an organization that would not be the tail of any kite. I am in the radio business to make money, but it strikes me that the Radio Corporation of America are making the money out of radio."

Arthur H. Ford, State University of Iowa, said no matter what commercial Stations might do, the universities would go on supplying broadcasting service. He was in favor of an organization that would include in its scope newspaper stations, university and school stations and stations operated by individuals or firms engaged in the radio business.

On motion of John P. Tansey, secretary of the Radio Club of Illinois, the chair appointed a committee comprised of Messrs. Donnelley, Walker, Ford, and the secretary to draw up an organization plan, which resulted in the selection of the officers already named.

Present at the meeting were:

B. L. Moore, Vice President of the Federal Telephone and Telegraph Company, Buffalo, N. Y. (WGR)

Frank W. Elliott, Vice President, Palmer School of Chiropractic, Dav-

(Continued on page 30)

How to Add One Step of Radio and One Step of Audio Frequency to the Reinartz Tuner

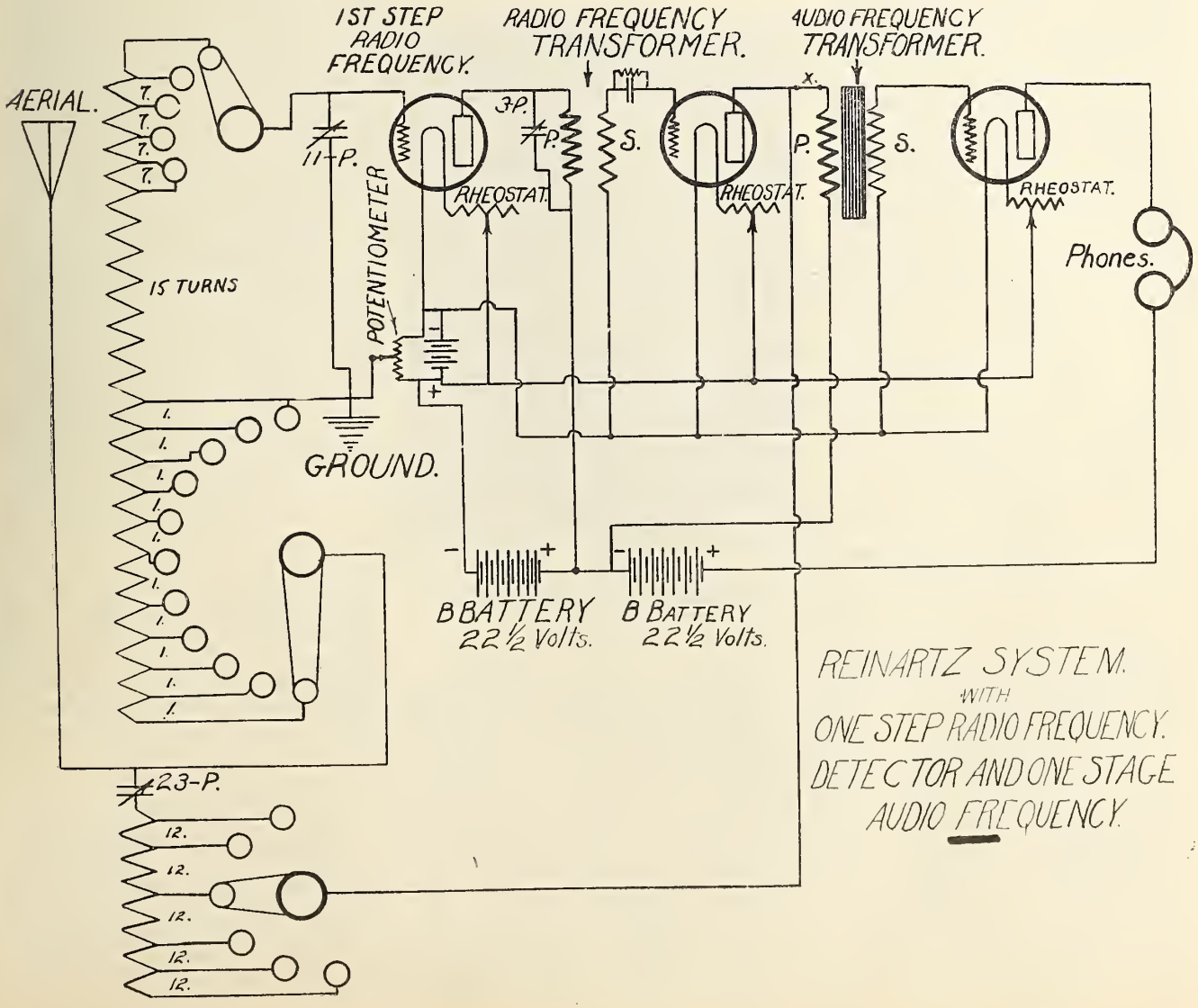
By F. D. PEARNE

WHILE wonderful results have been reported by the makers of the Reinartz set described in the September issue of this magazine and republished in this number, some of which showed reception from distances of 2,500 miles, still there are some of our readers who are anxious to see what this instrument will do with one or two stages of radio frequency added to it. Many amateurs seem to have an idea that radio frequency will add to the volume of the signals received, but this is an error, as I will show by a brief explanation.

Most all of our readers know that "radio frequency" is that in which the oscillations are too rapid to be heard by the human ear (usually calculated at 10,000 per second or more), while those frequencies which are audible (below 10,000 per second) are spoken of as audio frequencies.

The function of the detector tube is to rectify the radio frequency oscillations and bring them down to audio frequency. As the vacuum tube is also capable of magnifying the signals to some considerable extent, the detector may be termed both a rectifier and a relay.

Now let us consider a case in which one step of radio frequency amplification has been prefixed to the detector tube. An amplifier, or "hard" tube is used for this purpose. As all signals which are received upon the aerial come in at radio frequency and as they first enter the amplifying tube (the nature of which is to amplify, rather than to rectify) the signals are greatly amplified, or increased at



radio frequency. They are then carried to the detector tube, where they are rectified and brought down to audio frequency. From this it will be seen that radio frequency amplification will really magnify oscillations received upon the aerial and pass them to the detector tube for rectification.

This makes it possible to hear signals which otherwise would be too weak for detection in the detector tube. In other words, the radio frequency amplification will bring in weak signals from a great distance and strengthen them to such an extent that they can be heard after passing through the detector tube. Consequently it has been said that for long distance reception, use radio frequency amplification. After the signals have been rectified and brought down to audio frequency, they may then be amplified at this lower frequency to the desired volume, by means of audio frequency amplification. Here again the "hard," or amplifying tube is used, as the function of this part of the apparatus is to amplify only and as this amplification takes place at audio frequency, it is possible to listen in on one or two steps as desired. It would do no good, however, to listen in on the different steps of radio frequency, as at these points the oscillations have not yet been rectified and nothing would be heard. If properly designed and constructed, radio frequency amplification circuits will bring in signals from great distances.

The construction of the inductance, switches, etc., used in the Reinartz tuner is described in detail in this number, so only a brief description of that part of it will be given here and more detail will be used in describing the addition of the radio frequency amplification. The Reinartz tuner is due to the work of Mr. John L. Reinartz, of South Manchester, Conn., and consists of a spider-web winding, wound upon a slotted fiber, or bakelite disc, 1-16 of an inch thick and 6 1-2 inches in diameter. Eleven slots 1-8 of an inch wide and two inches deep are cut into it to accommodate the wires. The coils are best wound with No. 26 single silk insulated wire. The winding consists of two coils. The first, or inside coil has sixty turns, with taps taken off every 12 or 15 turns as desired. This coil is connected to the aerial through a 23-plate variable condenser, as shown in the drawing. The second coil contains fifty-three turns tapped and connected as shown. The inner coil of sixty turns is first wound in and out of the slots and the second coil is wound on the outside of it. These two coils are the only inductances used, thereby doing away with the expensive variometers and vario-coupler used in other types of regenerative sets. The adjusting is done by means of switches, the points of which are connected to the various taps shown.

The previous description of this set showed the tuner alone, with one step, and with two steps of audio frequency amplification, and to those readers who are familiar with the set, the arrangement of one step of radio frequency amplification will be seen at a glance. The additional apparatus used in this circuit consists of a potentiometer having a resistance of 400 ohms, a socket and amplifier tube, one additional "B" battery, a radio frequency transformer having a wave band limit of from 200 to 500 meters, and a rheostat.

These parts are the only additional material necessary to give a great increase in the receiving range. The revolving part of the eleven plate condenser must be connected to the ground, and the revolving part of the twenty-three plate condenser must be connected to the aerial. If particular care is not taken to see that these connections are made in this way, no results will be obtained. It has also been found that in case it is necessary to burn the filament of the detector tube at a very high temperature in order to get results when audio frequency amplification has been added, that an extra inductance consisting of a few turns of No. 26 wire connected in the circuit at the point marked "X" on the drawing, between the plate of the detector tube and the primary of the audio frequency transformer will make it possible to burn the filament at a much lower temperature.

This is not always necessary, but when it is needed, the builder should experiment and find out just how many turns are necessary for his particular set. In some cases, six turns will suffice and in others, more turns are needed. This inductance is usually wound on a miniature form similar to that used for the large coils. One "B" battery supplies the radio frequency and the detector tubes and the other takes care of the audio frequency tubes. The second set of "B" batteries can be omitted if desired, but it will be found that the set works better with a high voltage on the plate circuit of the audio frequency amplifier tube. In fact it is a good idea to use forty-five volts on the radio frequency tube, but if this is done it should be a separate battery with the negative terminal connected to the positive terminal of the "A" battery and the positive terminal connected to the plate side of the radio frequency transformer, which is shown in the drawing connected to the positive terminal of the first "B" battery.

The positive terminal of the first "B" battery is left connected as shown. A loud speaker may be substituted for the head phones to give greater amplification to the signals if so desired. The adjusting is done on the three switches and the two variable condensers as shown in the drawing. Any standard make of audio frequency transformer may be used, but in making the selection be sure that the transforming ratio is 10 to 1 for the first step and if another step is added, use a 3 to 1 ratio. Also in purchasing a radio frequency transformer, be sure that it is wound for the wave band which will cover the limit which you want to receive. The large inductance is usually mounted some distance away from the panel on which the switches and condensers are mounted, as this arrangement will give ample room for making the connections to the switch contacts and will also prevent interference caused by body capacity while adjusting the set. Another way to mount the coil is to use a sliding base to which the panel is attached, which will move in and out of the box when the panel is drawn out. The coil is then mounted horizontally on the base and the wires brought up to the switches for connection. It will take some little time and experiment for the operator to become acquainted with the adjustment of this set, as a difference of one point on either of the small switches will cut a station in or out, but after a little practice excellent results will be obtained.

Assistant Inspector

Lawrence E. Dutton, 1340 North Homan Avenue, Chicago, has been appointed an assistant to Radio Inspector E. A. Beane, of the Ninth radio inspection district. Mr. Dutton has commenced his work in the Federal building.

Photo-Electric Detector Tubes

By H. A. BROWN and C. T. KNIPP, University of Illinois

A YEAR ago the writers completed an investigation of the effect of various residual gases and various degrees of vacua upon the characteristics, constants and efficiency of detector tubes. The investigation showed that in the case of a low vacuum the optimum plate voltage for detector action decrease with the ionizing potential of the gas in the tube. The vapors of certain alkali metals have ionizing potentials of 4 volts and less, and some of these were experimented with. It was found that the vapor of potassium-sodium alloy, having an ionizing potential of 4 volts, when present in the ordinary three-element vacuum tube or Audion caused it to function as a very sensitive detector of high frequency oscillations at a plate potential of 5 to 10 volts. Tests in this laboratory have shown that this tube is from 3 to 5 times more sensitive on weak signals, with 8 or 10 volts plate potential, than is the same type of tube containing any of the commonly used gases, such as argon and helium, and which require 18 to 25 volts. This latter is the widely used "gas content" or "soft" detector tube. In spite of the extremely low plate voltages needed for this alkali vapor filled tube it is not "critical" in adjustment of plate voltage as is the conventional "soft" detector.

Fig. 1 shows this clearly, curves A representing three different tubes each primed with alkali vapor, and curve B for the conventional "soft" detector tube. Users will appreciate this advantage.

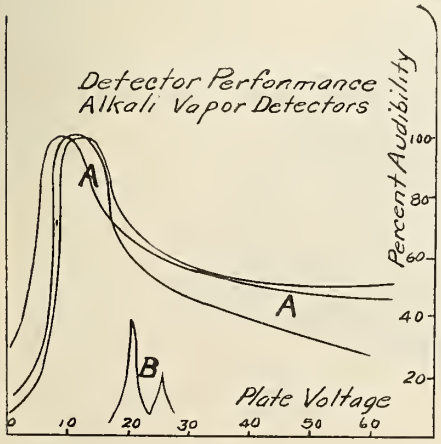
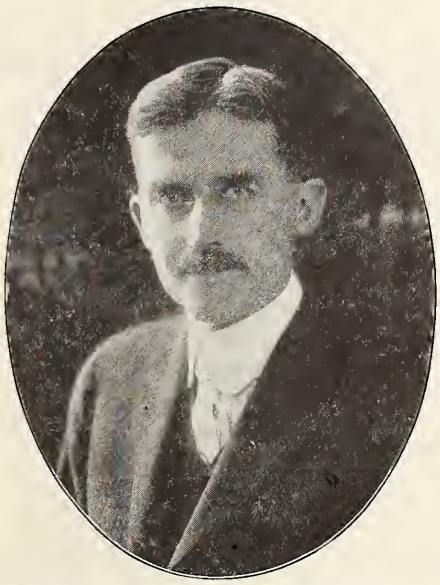


Figure 1.



Professor Charles T. Knipp, University of Illinois

H. H. Brown, Associate in Department of Electrical Engineering, University of Illinois

The most astonishing discovery about this tube is the fact that it operates efficiently at zero plate voltage.

Fig. 2 shows the characteristic curves for one of these tubes, the lower curve being taken at zero plate voltage. To do this the plate circuit return was connected to the negative filament terminals. The plate current flows through the vacuum from the plate to the filament in spite of the opposing effect of the filament drop. This curve shows the plate current to be about 1 milliampere at zero grid voltage. As is well known, the potassium-sodium alloy is used as the sensitive coating in the photo-electric cell, a device which furnishes a source of feeble electric current when light shines upon it. In all probability the source of plate current in these tubes at zero plate voltage is the photo-electric effect of the alkali vapor, the luminous and non-luminous radiation from the filament being the source of energy.

These photo-electric detector tubes function very well as detectors of damped and undamped waves and of radiophone modulated waves. As a test several of the tubes were tried out. Using one tube as a detector together with a "variometer" type of regenerative tuner, and an antenna 45 ft. high, the broadcasting stations at Schenectady, N. Y., Detroit, Pittsburgh, and Chicago were heard in this locality without an amplifier and with a directly measured audibility of about 30. When a plate voltage of 6 to 10 volts was applied the audibility increased to 150, this corresponded with the results of the carefully made laboratory tests shown in Fig. 1. At zero plate voltage the tube was used to receive the 17,000 meter station at Annapolis by the beat method, the tube oscillating very easily and steadily. It is equally efficient on short wave amateur C. W. reception.

The foregoing features in addition

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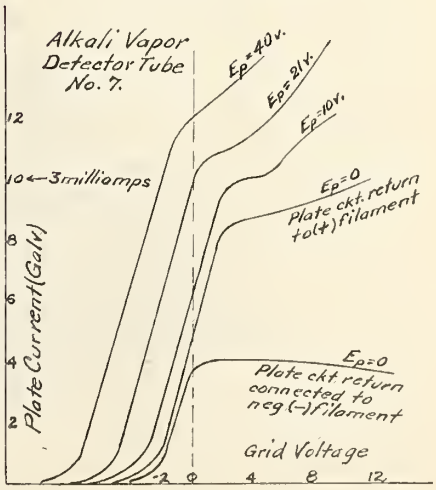


Figure 2.

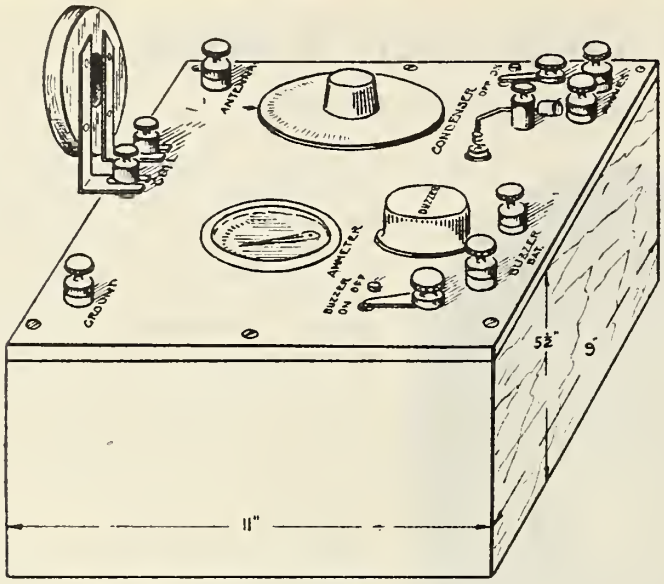


FIG. 1. ONE ARRANGEMENT OF WAVEMETER BOX AND ASSEMBLED UNITS.

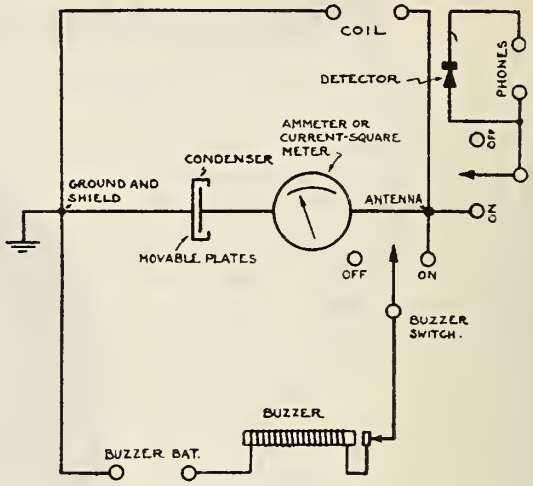


FIG. 2. WAVEMETER CIRCUIT.

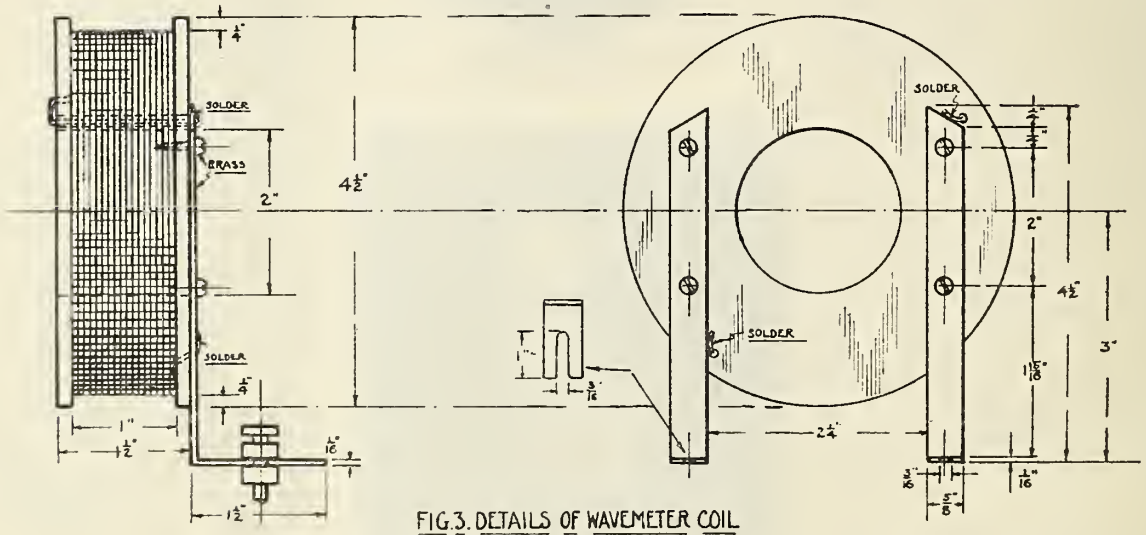
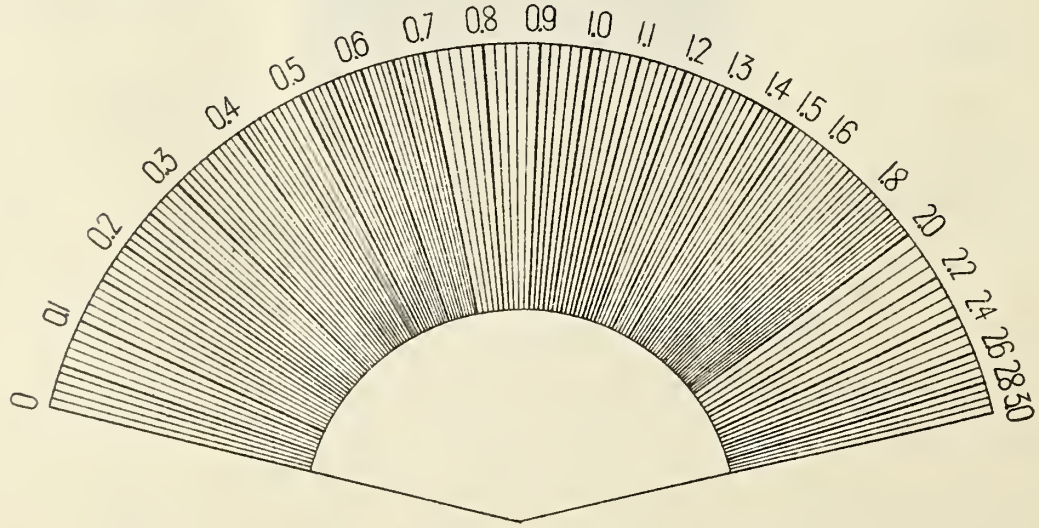


FIG. 3. DETAILS OF WAVEMETER COIL



DECREMETER SCALE.
FIG. 4.

Design of a Portable Short-Wave Radio Wavemeter

By U. S. Bureau of Standards

A WAVEMETER is a device for measuring the frequency or the length of radio waves. Radio waves always travel with the same velocity, and if the frequency is known, the wave length is also known.

Resonance is a most fundamental phenomenon of radio. When the inductance and capacity of a circuit on which an alternating electromotive force is impressed are adjusted so that the impedance of the circuit is a minimum and the current flowing in the circuit is a maximum, the circuit is said to be in resonance. For information regarding resonance and the measurement of wave length, reference may be made to "The Principles Underlying Radio Communication," Signal Corps Radio Communication Pamphlet No. 40, and to Bureau of Standards Circular No. 74. These publications may be purchased from the Superintendent of Documents, Government Printing Office, Washington, D. C. The price of the former is $1.00, and the price of the latter is 60 cents.

Amateur radio stations in the United States are at present required by law when transmitting to use wave lengths not exceeding 200 meters, and it is therefore important that amateur operators should have a wavemeter available so that they may adjust their transmitting sets to comply with the law, and it is necessary that this wavemeter should be adapted to measure short wave lengths such as 200 meters. Other comparatively short wave lengths such as 360 and 485 meters, are now used for radio telephone broadcasting, and it is important to have a wavemeter which can measure these wave lengths. The Radio Telephony Conference which met in Washington in February, 1923, recommended narrow bands of waves for particular services, some bands being only 10 meters wide. Stations which must work within such narrow bands must be provided with well-designed wavemeters if they are to comply with the requirements of the law. The design of a portable short-wave wavemeter is therefore a matter of importance. It is the purpose of this circular to point out the most important considerations in the design of such a wavemeter, and to describe the

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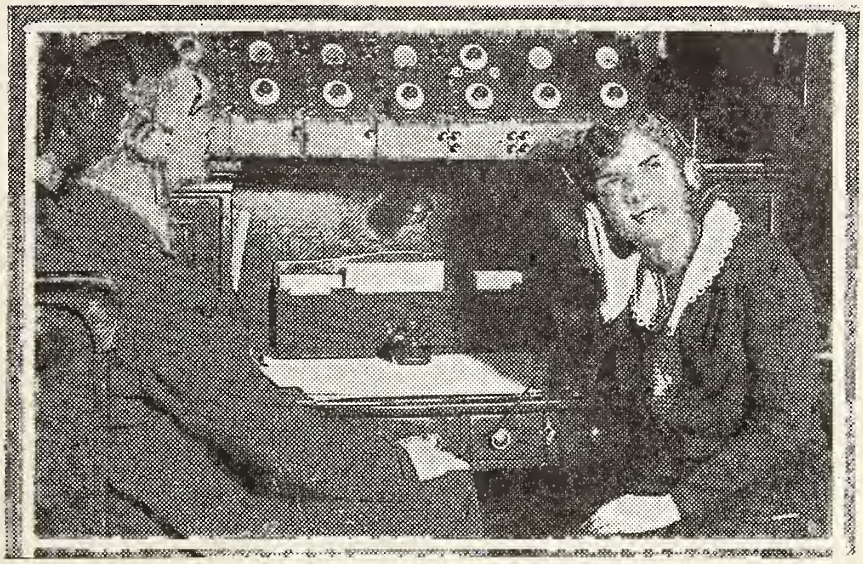


Operating radio receiving set inside steel car on speeding Pennsylvania train.

Receives in Speeding All-Steel Car

PIERCING the all-steel construction of a railway passenger car on the Broadway Limited, the Pennsylvania Railroad's crack flyer, radio signals were successfully received on October 13 by a set entirely within the car, without outside antennae, while the train was speeding between New York and Chicago.

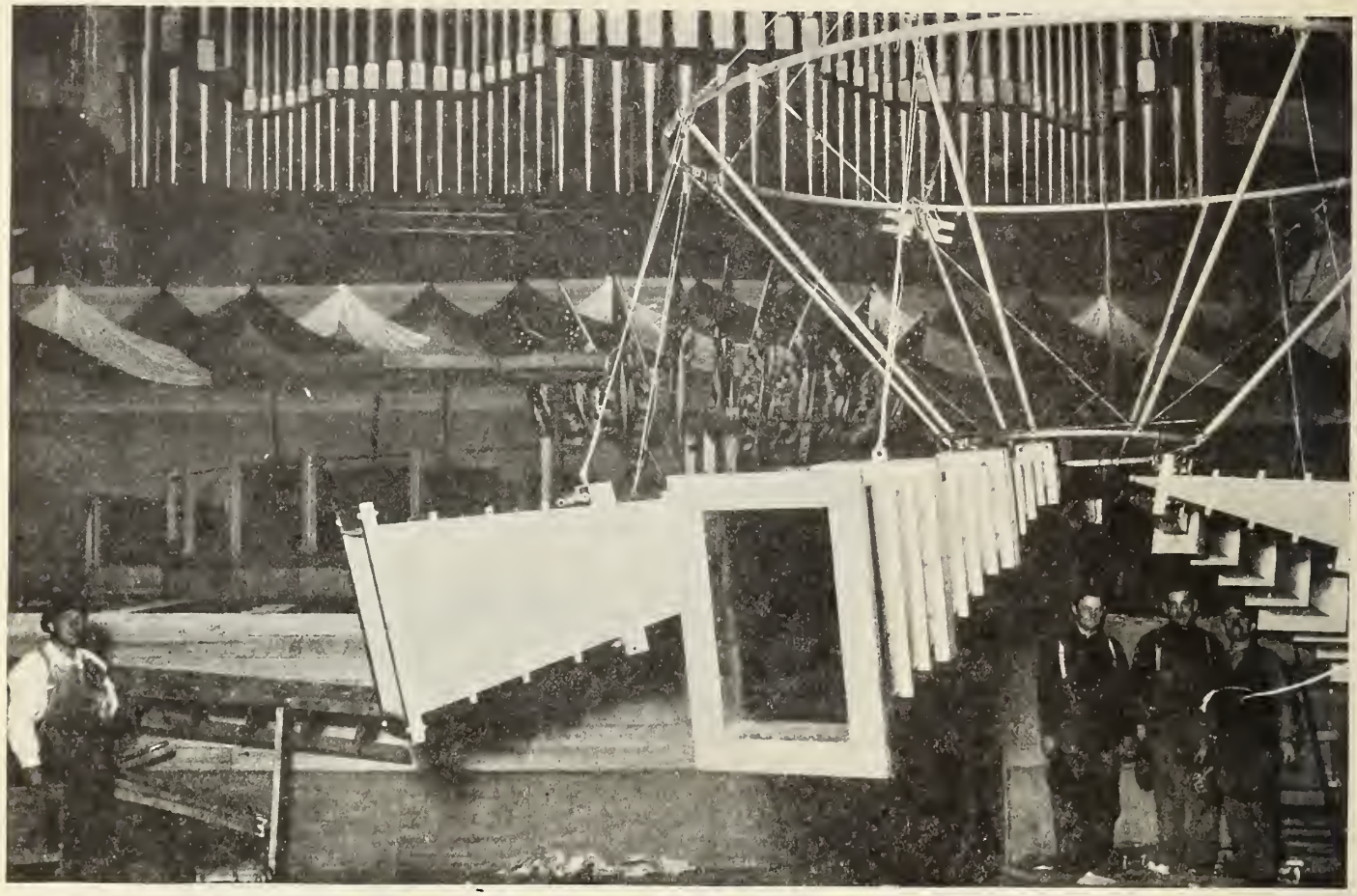
A few strands of wire around an eighteen-inch frame attached to the set served as the receiving apparatus by which music and speech were caught from half a dozen stations en route. The tests, the first to be made on a moving train without an outside aerial, were conducted by Arno Zillger, chief engineer for the E-D Manufacturing Company, of Philadelphia, enroute to the Radio Show in Chicago.

Mr. Zillger used an ordinary receiving set without any extra attachments or special parts, setting up the apparatus in 17 minutes as the train was about to leave Philadelphia and immediately tuning in to catch broadcasting from John Wanamaker's in Philadelphia. Even the 11,000 volt electric wires over the railroad tracks, where the Pennsylvania is electrified to Philadelphia suburbs, did not interfere with the receiving.

Continuing the test through the evening, Mr. Zillger listened to messages and concerts from Newark, Schenectady, an ore boat on Lake Erie, Pittsburgh and numerous other points.

J. D. Jones, superintendent of Telegraph and Signals for the Eastern Region of the Pennsylvania Railroad, was one of the most interested observers of the experiments. The possibility of the use of radio in giving and receiving train orders is at present a subject of investigations on several roads and the results of Mr. Zillger's tests threw considerable light on the problem. Since the initial tests, Mr. Zillger has designed a new set especially for use on moving trains. This set will be given a try-out soon.

The practicability of radio for use in communicating between the engine and the caboose of long freight trains, and between trains and stations along the line, is one of the angles which Pennsylvania railroad officials are watching closely. The results of last week's experiments, Mr. Zillger said, show that the idea is workable and that his set, with a few modifications, would prove successful in such work.



Arrangement of loud-speakers in Congress Hall, Pageant of Progress, Chicago. (By courtesy of Greater Chicago Magazine)

Expert Explains Radio Frequency Amplification

By CHARLES KILGOUR, Engineer, Crosby Mfg. Co.

RADIO Frequency Amplification is regarded at present as the most interesting subject connected with wireless telephony, and Charles Kilgour, who is in charge of the engineering department of the Crosley Manufacturing Company, Cincinnati, Ohio, operators of the radio broadcasting station WLW, has prepared the following interesting explanation of it. Mr. Kilgour has dealt in terms of the layman and made his explanation so simple that a beginner may understand every word of it. Mr. Kilgour said in part:

"A radio enthusiast is not satisfied with a mere definition of radio frequency amplification. He wants a plan of construction, for a great part of radios fascination is due to the ease with which it is possible to try out various schemes for making audible the infinitesimal waves of the ether which constantly are lapping upon our aerials.

"The first essential of a radio frequency amplifier is a proper vacuum tube. Any standard amplifier tube will serve. Upon the grid of this tube is impressed incoming alternating current. This is accomplished by connecting one side of the secondary coil to the grid and the other to the filament circuit. No grid condenser is used because the tube acts as an amplifier and not as a rectifier or detector.

"To cause a vacuum tube to amplify properly the voltage impressed upon its grid, it is necessary to place an impedance, or resistance, in the plate circuit, which is the connection between the plate and the filament. It is also necessary to hold the plate at a positive potential of about 45 volts with respect to the filament. This is accomplished by the familiar 'B' battery.

"The high impedance required in the plate circuit may be obtained in several ways. A high ohmic resistance may be used, but as this has a high resistance to direct current it opposes the action of the 'B' battery, thus introducing difficulties.

"An inductance or coil may be used to set up the necessary impedance. An inductance may have very low ohmic resistance and so not interfere with the proper action of the 'B' battery and at the same time, due to its reactance offer high impedance to an alternating current such as we wish to amplify. At the high frequency handled a condenser or capacity effect is always present in a coil. This is equivalent to connecting a condenser across the terminals of the coil. This capacity, together with the inductance of the coil, forms a closed circuit which has a natural period of oscillation or is resonant at a certain frequency. It is a peculiar quality of such a circuit that it offers a very high resistance to an alternating current of the natural frequency of the circuit.

"In other words such a coil introduced in the plate circuit of a vacuum tube will have a high impedance to one frequency and will cause currents of that frequency to be greatly amplified. It is essential, however, that the amplifier works properly on various wave lengths. For this reason the ohmic resistance of the coil may be increased, broadening the range of the amplifier but reducing its efficiency.

"By far the best solution of the problem is the use of a rather small inductance with a variable condenser connected across its terminals. The same sort of a circuit is formed as in the last case, but the variable condenser makes it possible to change the natural period of the circuit and so amplify a signal of any desired frequency within the range of the condenser and coil. The ohmic resistance of such a condenser and coil may be very low and paradoxically the impedence at resonance as a consequence will be extremely high.

How to Construct a Good Reinartz Set

(Republished in response to scores of requests)

By F. D. PEARNE

Chief Instructor in Electricity at Lane Technical High School

FOR the amateur who wants to build a real receiving set and does not feel that he can afford to spend the money, I submit the following specifications of the Reinartz tuner, which, according to my many correspondents, is giving far greater satisfaction than the well-known vario-coupler and variometer set. This set is claimed by many users, to bring in signals which cannot be heard with the other well-known types, and the small investment required to build it is one of the features which recommend it to the experimenter. All of the inductances are wound upon the same form, which are of the well-known "spider web" type.

Construction.

The mounting is made by cutting out a disc of fibre one-sixteenth of an inch thick and six and one-half inches in diameter. If fibre cannot be obtained, good heavy cardboard can be used, but it must be very carefully varnished with shellac before the winding is put on. Cut out the disc as described and divide the outside edge into eleven parts. Draw a circle two and one-half inches in diameter upon the disc to locate the bottom of the slots, then at each of the divisions cut a slot one-eighth of an inch wide from the outside edge to the inner circle so marked.

After all the slots have been cut, a coat of shellac varnish, or celluloid cement, is put on and, when dry, the form is ready for winding. It is a good idea to study the circuit as shown in Figure 3 before starting to wind. Note where the taps are taken off, as a great deal depends upon just the right number of turns being used. Leave all taps at least twelve inches long, so that no splicing will have to be done when the inductance is connected to the switches. The best wire to use for the winding is No. 26 cottenamel or silk enamel insulation, although plain cotton insulation will do if the maker is careful in his work. Begin winding at the bottom of any one of the slots, leaving an end at least twelve inches in length for connections. Wind in and out of the slots as shown in Figure 2 until fifteen turns have been put on. In counting these turns after they have been put on remember that only one-half of the turns will be visible on one side of the disc, so that when seven turns show on one side and eight on the other, it means fifteen complete turns.

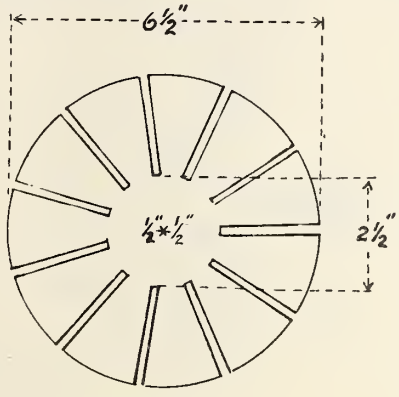


FIGURE 1.

When fifteen turns are in place, make a twelve-inch loop, twisting it together, so that this twist will come up tight to the slot, then the tap will not lose its identification among the numerous other taps to come. Continue the winding in this way, taking off a tap at every fifteen turns until sixty turns are in place. At the last turn cut the wire off, leaving the twelve inches for connection. If these instructions have been followed faithfully there will now be three taps and two ends projecting from the disc. It is a good plan to bring out these taps in different slots; that is, the first tap comes out in the next slot to the one in which the coil was started and the next tap in the next slot, etc., as this makes the identification of the wires much easier. This coil is shown at the bottom of the diagram in Figure 3, and is marked "inside coil."

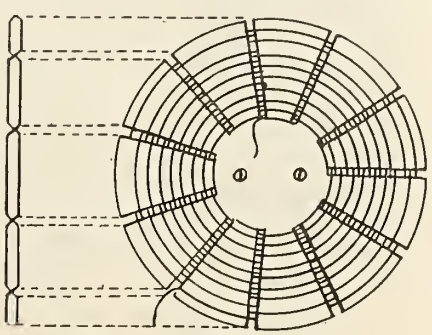


FIGURE 2.

Now start the next coil in the next vacant slot, leaving the customary twelve-inch end; wind one turn only and bring out a loop. Continue in this way, taking a tap off at every turn until you have ten turns. Instead of cutting the wire at the end of the tenth turn, bring out another tap and wind fifteen more turns before you bring out the next tap. After the tap on this fifteenth turn, wind twenty-eight more turns, tapping them at every seventh turn, except the last one which will be a single end, as it is the finish of the winding. Now check up the number of turns with the diagram Figure 3 and see that the correct number of turns have been put on. There should be sixty turns on the inside coil and fifty-three on the outside coil. Now after the winding is completed, paint the coil all over with some insulating varnish, such as shellac or celluloid cement. Both of these windings together will just about fill the form. The best way to mount the coil is to cut off a piece of curtain-pole (wood) about one inch long, place it against the center part of the disc and fasten it to the panel with two brass screws. (Do not use iron screws, as they will tend to dampen the oscillations.)

If the set is to be mounted in a cabinet, it will be better to mount the coil with a piece of curtain-rod on a separate piece of wood, in an upright position, as this will give better access to the wires when it comes time to make the connections. The switches and contact points can be purchased at any radio supply store. Two variable condensers are necessary, one shown at "C" in Figure 3 should have a capacity of .001 M. F. and the one shown at "D" in the same figure should have a capacity of .0005 M. F. The rest of the apparatus required is the same as that used in any other regenerative set, viz.: One grid leak and condenser, one detector tube and socket, one storage "A" battery (6 volts), one plate, or "B" battery (twenty-two and one-half volts), and one pair

of two or three thousand ohm receivers.

Figure 3 shows how all the connections are to be made, and the builder can mount the outfit as he pleases, either in a box with a panel front, or on a table or base-board. The method of winding the coil is shown at "B" in Figure 2. If this set is carefully constructed, the results obtained will surprise the most skeptical reader and with one step of amplification it will produce results equal to two steps of amplification on the vario-coupler and variometer set. The amplifier, however, should be of a specially designed circuit, which will be explained for those wishing to add it to their sets.

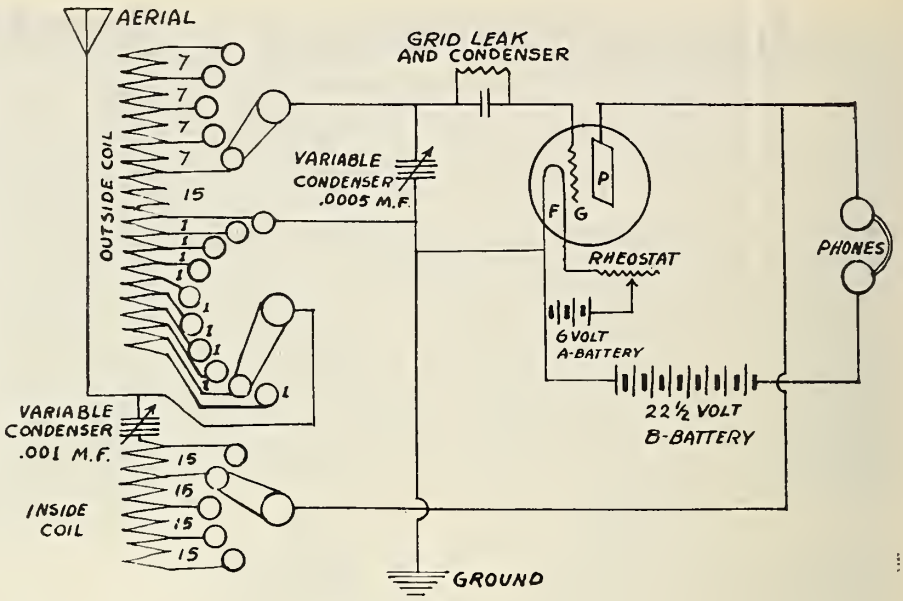


FIGURE 3

Amplification for Reinartz Tuner.

Figure 4 shows the method of adding one step of amplification to the Reinartz tuner. In this circuit a variable condenser is shown in place of the grid-leak and condenser. The use of either of these is optional with the builder. The variable condenser will give better tuning effects, but the set will work very well if the grid-leak and fixed condenser is used; in fact, the set from which these specifications were taken used the fixed condenser and grid-leak. The method of connecting the amplifier to the circuit is similar to that of the ordinary circuit. The head phones are removed from the circuit shown in Figure 3 and replaced with the primary winding of ten to one ratio audio amplifying transformer. In the set from which these specifications were taken, this primary winding of the transformer furnished enough reactance to make the tube oscillate properly, but this is not always the case. If it is found that the filament has to be burned at a dangerous degree of brilliancy to produce the oscillations, then an extra inductance should be inserted in the circuit at the point marked "X" in Figure 4. If however, the tube is found to oscillate without crowding the filament, then this extra inductance "X" should not be inserted.

If it is found that the inductance is necessary it can be made by making a small form similar to the one on which the two coils are wound, but much smaller, and winding six turns of wire of the same size as that used on the large coil. This has been found by experiment to be the correct number of turns and should not be changed. The secondary of the transformer is connected to the grid and filament circuit as shown in Figure 4.

The circuit shows only one set of "B" batteries used for both the detector and amplifier tube plates, but stronger signals may be obtained by adding another twenty-two and one-half volt "B" battery between the head phones and the battery shown on the drawing. This is shown in Figure 6. It is absolutely necessary to see that the positive side of the "B" battery is connected to the part of the circuit, which eventually gets to the plate, and the negative side must always be connected to the filament. Another important thing is to see that the rotating part of the condenser "C" is connected to the aerial, and that the rotating part of condenser "D" is connected to the earth. The set will not give good results unless this is done.

The connections to the aerial, ground, and batteries are taken out through the back of the case, to avoid using binding posts on the front of the panel, as this always makes an unsightly wiring job. If

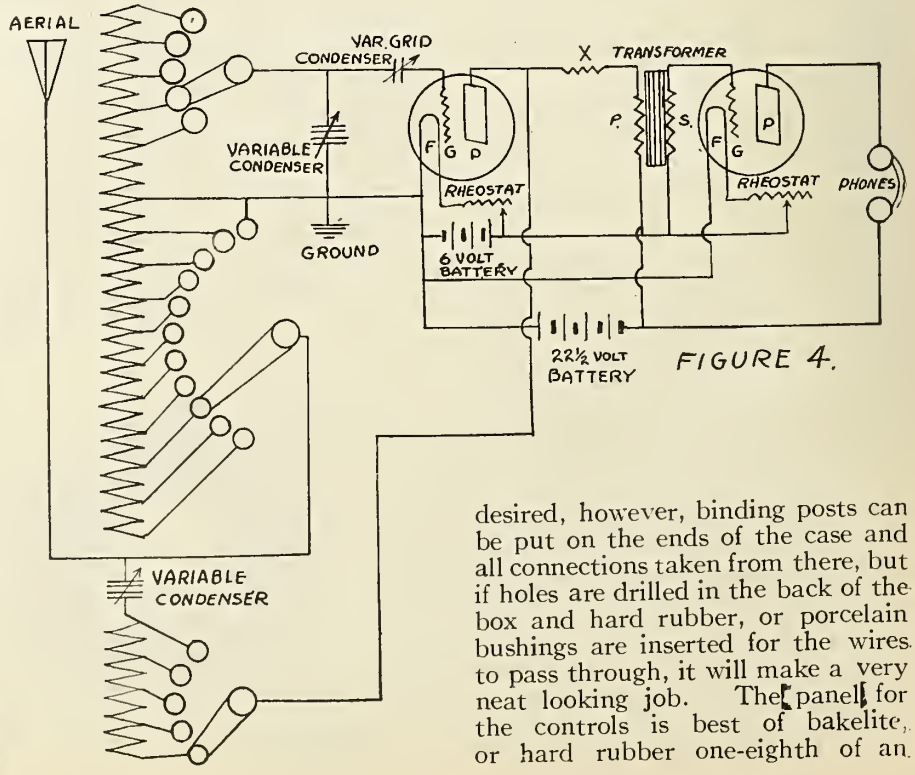


FIGURE 4.

desired, however, binding posts can be put on the ends of the case and all connections taken from there, but if holes are drilled in the back of the box and hard rubber, or porcelain bushings are inserted for the wires to pass through, it will make a very neat looking job. The panel for the controls is best of bakelite, or hard rubber one-eighth of an

inch thick, eighteen inches long and eight inches high. The sockets and tubes are mounted directly behind the controlling rheostats and the holes in the panel shown above the rheostats are for the purpose of watching the brilliancy of the tube filaments.

The two dials shown are used for the purpose of adjusting the variable condensers and if a variable condenser is used in place of the fixed condenser and grid-leak, then another dial must be used for this purpose and the arrangement of the panel will have to be altered to suit the case. The spider-web coil is mounted as far back in the box as possible and is placed directly behind the switches to facilitate the connections. The addition of this amplifier will make a wonderful addition to the set, but if it is desired to carry the amplification farther, another step of audio frequency amplification may be added.

Addition of the Second Step of Amplification.

Figure 6 shows the method of adding two steps of audio frequency amplifications to the Reinartz tuner. While this addition is very seldom necessary, still there are some fans who can not get signals too loud to suit them and this circuit is shown for the benefit of those who want to go the limit. When I say limit, I think I have found a good word, for this is about as far as the amplification can go with this set without injury to the receivers, or loud speakers.

The diagram shown in this figure will be clearly understood without going into details, if the reader has carefully followed through the preceding circuits. The only changes shown are in the addition of the second step, and the addition of two more "B" batteries of twenty-two and one-half volts each. These batteries must be connected in such a way that the positive of one of them connects to the negative of the next, etc. This is clearly shown in the diagram. If a loud speaker is to be used in any of the circuits, it is placed where the receiver is shown in the different diagrams. The transformers used may be of the ordinary audio frequency type, the one used in the first step to be a ten to one ratio, while that used in the second step is a three or three and one-half to one ratio. Any one of these circuits will give great satisfaction to the user and with a little patience and care in adjusting he should have no trouble in receiving signals from 1,500 miles in the winter time.

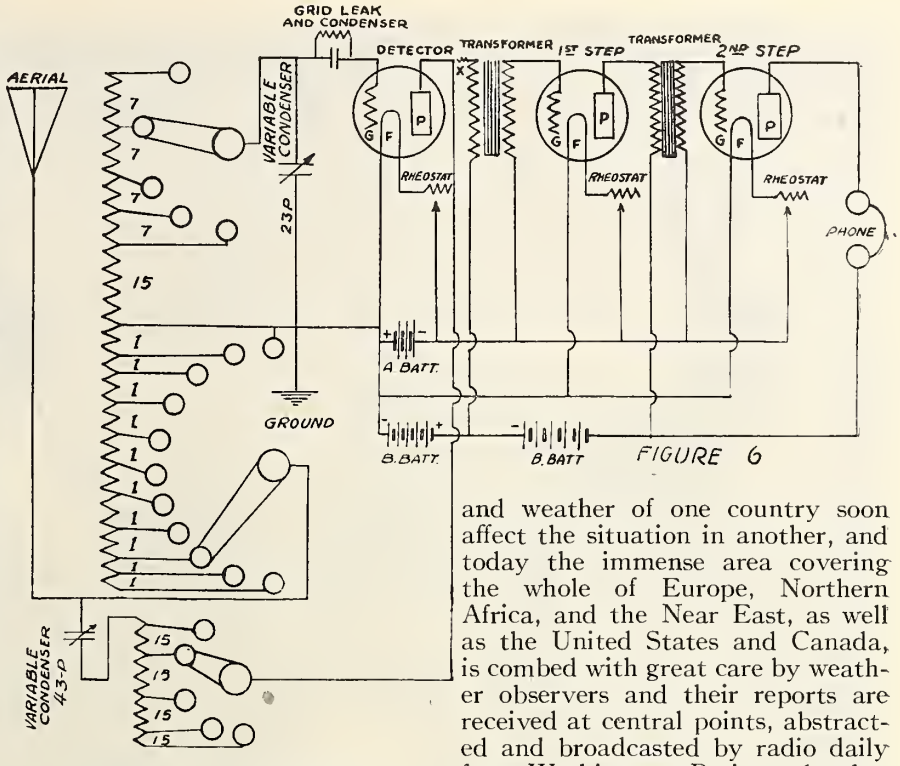


FIGURE 6

Radio Extends Weather Forecasts

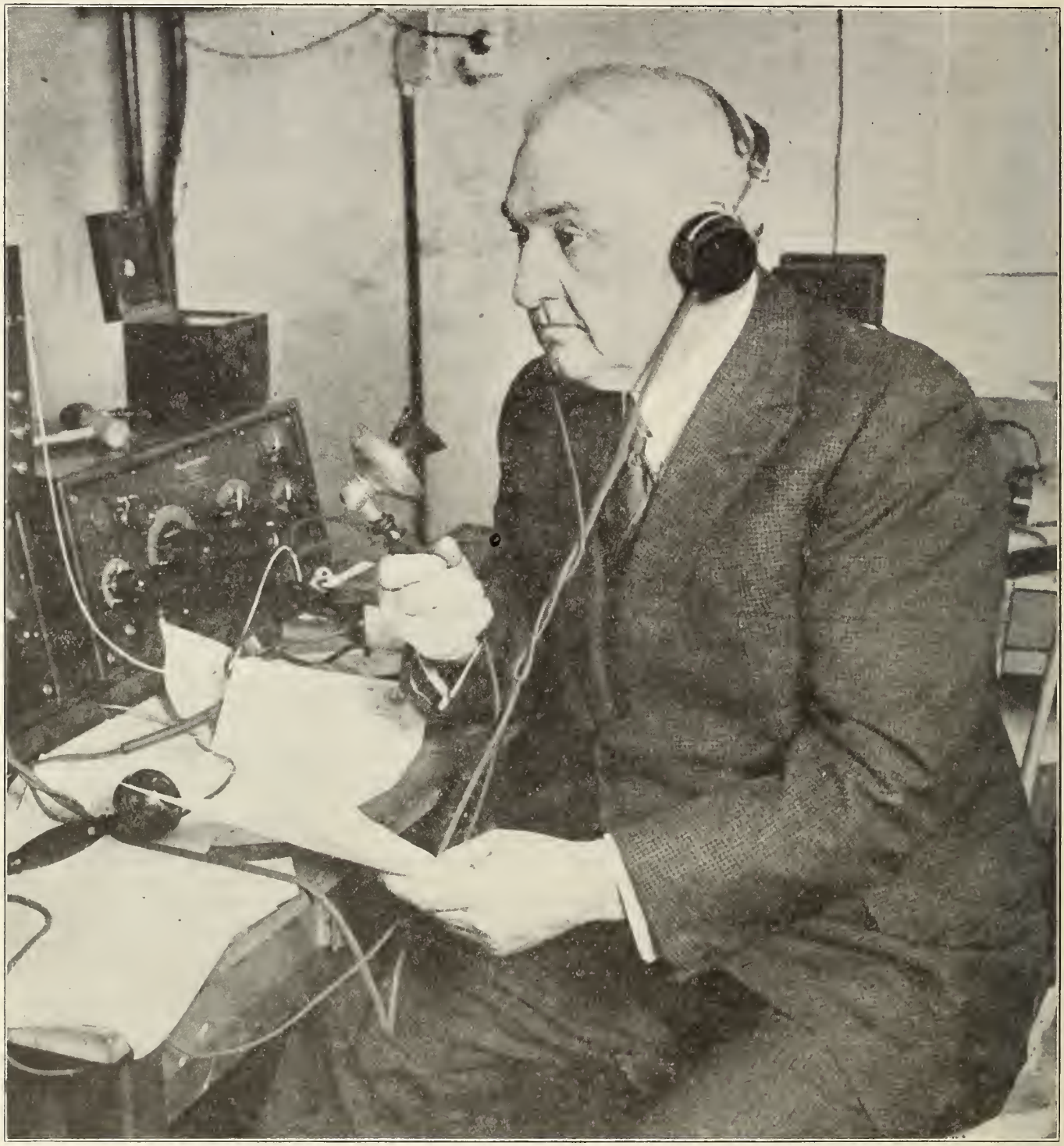
With the perfection of radio communication great progress has been made in another science, which is perhaps of equal value to the world at large, particularly the seafaring and agricultural nations; meteorology has advanced with leaps and bounds within the past few years, due chiefly to the use of radio the outposts of meteorological knowledge have been pushed far afield into distant and unpopulated wilds where previously lack of communication has withheld local weather conditions from the world.

Last winter, an American engineer, Hagbard D. I. Ekerold, spent many months on a barren rock 400 miles north of Iceland, in the Arctic Ocean, as the leader of a meteorological expedition backed by the Bergen Geophysical Institute. His observations were believed so important to the rest of the world that an observatory was established by the Norwegian government at Jan Mayn—this lonely spot of rock in the Arctic sea. Needless to state, this new northern observatory has a wireless station, so that weather observations can be broadcasted as fast as noted. Scientists hold that this, the station farthest north, is the beginning of a new epoch in the history of science, admitting that credit is due to radio in a large measure.

Meteorology is fast becoming an international study, for the storms and weather of one country soon affect the situation in another, and today the immense area covering the whole of Europe, Northern Africa, and the Near East, as well as the United States and Canada, is combed with great care by weather observers and their reports are received at central points, abstracted and broadcasted by radio daily from Washington, Paris, and a few sub-stations. Thus it has become possible for meteorologists to obtain within twelve hours of the taking of the observations, a representative meteorological situation over the greater part of the Northern Hemisphere, extending from the Pacific Coast of America in the West to Russia and Egypt in the East.

Professor Bjerknes of Norway, who has done much to advance our knowledge of cyclones, forming in the temperate zones, holds that weather conditions there depend chiefly upon the conflict between two streams of air—a cold current flowing southward from the north Polar regions and a warm current drifting northward from equatorial sources already well-known. These air streams, he believes, meet along a wavering front in the Temperate Zone, and in their intermingling give birth to those mysterious swirls in the atmosphere which are called cyclones.

To study these possibilities, he desires to establish a chain of radio equipped observation stations around the Pole, from the records of which the tracks followed by the Polar current southward and the centers of conflict with the warm currents may be definitely determined. Such a series of circumpolar meteorological posts will have more than theoretical importance when regular forecasts for the North Atlantic are required in connection with daily air flights between Europe and America, he says.



Radio and Law Enforcement

JAMES M. DAILEY, Democratic nominee for sheriff of Cook county at the November 7 election, is the first aspirant to the office of chief law enforcer for a great metropolitan district, such as surrounds Chicago, to recognize the radio as a real and effective aid to protecting the public and capturing criminals. He tested out the wonders of radio broadcasting through a terse talk sent out from Station WDAP, the de luxe plant of the Midwest Radio Corporation atop the Drake Hotel on October 14.

Speaking on "Highway Safety" Mr. Dailey carried his campaign to thousands of radio users in Chicago and Cook county and concluded by saying:

"I am not in favor of fancy stunts in law enforcement and believe generally in the single policy of Common Honesty and Common Sense —but radio is not a stunt nor a new toy. It is a real working force in the modern world and I can foresee it can be used to communicate quickly with the entire citizenry of a city or county to carry messages of great public importance. In emergency cases it will be invaluable as an aid to law enforcement and as Sheriff of Cook county I intend to use every means to make this the cleanest community in the country."

Public Education in Radio Urged

Dr. Alfred N. Goldsmith and Paul F. Godley Tell How to Popularize Art of Wireless Communication

By GEORGE R. HOLMES, I. R. E., A. J. E. E.

Special to Radio Age

NEW YORK, October 4.—"One of the greatest problems we have to face today in radio is that of educating the public at large in the intelligent use of radio apparatus, if we are going to keep alive interest and stop people from becoming disgusted with their sets," declared Dr. Alfred N. Goldsmith, secretary of the Institute of Radio Engineers before a large gathering of radio engineers and enthusiasts, at the Engineering Societies Building this evening.

"The time is past when anyone can take a cardboard tube, wind it with wire, use a piece of crystal and any old head phone and expect to get real satisfaction from radio," he said. "It will work sometimes, any old time, but it won't work all the time and especially when the user knows little or nothing of tuning and uses an antenna that is entirely out of proportion to the needs of the set.

"The same holds true of vacuum tube sets, where the average user has a sad lack of knowledge of plate and filament currents and voltages, and aerials that are entirely to big, long and of freak construction. The result is poor selectivity, improper regeneration and general dissatisfaction with the set.

"At the present time there is much talk that the change in having two broadcasting wave lengths does not solve the problem of interference. The truth of the matter is a lack of education on the tuning of the set.

"If the average user cannot tune out between stations using the two wave lengths, what will he do when we are using broadcasting wave lengths within a few meters of each other? That time is soon coming and with separation in broadcasting wave lengths about 12 per cent, it will be possible to hear any station individually without interference if the person really knows how to tune a set. By this we will have not only one or two programs to listen to but possibly a dozen with greater diversity and the listener can choose from a wide range his evening's entertainment.

"With the rapid strides being made in broadcasting the subject of paramount importance is education in the proper tuning of sets. When this is accomplished we will have made a great step forward and an important step."

Expressing his views on the subject Paul Godley, famous for his trans-Atlantic work said, "In trying to popularize radio we went back to the simplest forms of equipment and now that we are progressing we have fallen into hot water, through the fact that there is a lack of education on how to intelligently operate radio receivers. It is high time that intensive education be employed to help users of radio sets get over the small difficulty of tuning on 360 and 400 meters without interference.

"The same condition exists today in radio as existed in the auto industry when they changed from the car of simple adjustments to the present day complicated mechanisms. The public must understand that they cannot do with a $5 receiver the things that can be accomplished with a $200 receiver and there is a need of education to let them know what they should expect for the money they give out. The public at large should learn that it can't expect results and selectivity unless they do a little tuning. If they would take a third of the time used to learn how to run their new car, to learn about the operation of a radio set there would be less trouble but—they won't make the effort to learn.

"In selling radio sets the thing to do is not to push anything on the public but what is the best from an engineering standpoint. I seriously think that the radio publications of the country should be willing to promote and cooperate in organizing an educational campaign, as thousands have been disgusted through the junk they bought, fully believing that it would operate the same as the most expensive sets. What the people want is quality and real service from their radio sets just the same as they look for it in their phonographs.

Here's the First Central Exchange for Radio Calls

WHAT is said to be the first radiophone exchange in the world was recently opened at Croydon, England, the point from which the air lines to the European Continent take their departure, according to Consul Linnell.

The chief use made of this exchange is to connect the serial traffic controller, who has his headquarters in a control tower at Charing Cross, London, with the pilots of the air expresses flying between Croydon and the Continent.

This wireless exchange can also connect the phones of the airships and airplanes, while in flight, with any office at the aerodron at Croydon, making direct telephone conversation possible.

The pilot of each aerial transport is now required to report his position to the traffic controller every fifteen minutes, so that the progress and position of each plane is known throughout its journey. The controller is of partieular value in directing the course of the aireraft in cases of fog, and in giving them speeial directions for landing.

A Boost from Boston

Among the letters received commending the article on the Reinartz tuner, written by Mr. Pearne for the September issue, we take space for reprinting only one. It is addressed to Mr. Pearne and reads as follows:

I was very much interested in reading your article relative to the Reinartz receiver which appeared in the September issue of Radio Age.

Please allow me to compliment you upon the excellent manner in which you have handled the description and method of construction. This is the first article on the Reinartz circuit and its practical application that is concise enough to be of any practical value—at least the first which I, myself, have noted.

Sincerely yours,

EVERETT P. GORDON,

Advertising Manager, Atlantic Radio Company.

Tube Set Operates Across Atlantic

ACCORDING to announcement made by officials of the Radio Corporation of America another scientific accomplishment looking toward trans-oceanic telephony and the use of vacuum tubes for trans-oceanic telegraphy was made yesterday, when an experimental, high-powered tube set at Radio Central, Rocky Point, L. I., was operated continuously sixteen hours, handling commercial trans-Atlantic traffic with Great Britain and Germany, on a wave length of 19,000 metres.

The statement reads that plans for the development of the new electron tube experimental set were completed in December, 1921, by representatives of the Research and Engineering Departments of the General Electric Company and the Radio Corporation, and the manufacturing of this highly delicate and specialized set was immediately started in Schenectady, N. Y. So fast did the work progress that in May of this year the temporary installation of the set was started at Radio Central, and when Senator Marconi visited the station in July, preliminary tests were in progress under the direction of W. R. G. Baker, of the General Electric Company, and C. W. Hansell of the Radio Corporation.

The set itself is for the time being composed of three 50 kilowatt, 15,000 volt, water cooled, metal vacuum tubes, known in the engineering world as kenetrons, used as rectifiers, and six 15,000 volt, 20 kilowatt, water cooled, metal pliatrons, used as high-frequency converters. For the experiment with the tube set one of the new mile and a half long antennae suspended from six towers, 426 feet high, of the Rocky Point Station, was used, and the tube set succeeded in developing and sustaining in the antennae a current strength of 350 amperes.

So successful was the set in operation that the operators actually controlling the automatic sending keys at 64 Broad Street in New York City did not know that they were controlling a tube transmitter rather than an alternator until after the test was completed. An official of the corporation said:

"The operators on the English and the German circuits, if they noticed a change in the quality or the strength of the received signal, did not comment on it, so we assume the signal was favorably comparable to the alternator signals. Of course, this is the first time in the history of wireless telegraphy that a high-powered tube transmitting set has operated for so long a period over as great a distance as that between New York and Germany."

The British Marconi Company have in their station at Carnavan, Wales, a tube set made up by paralleling 60 air cooled, fragile, glass vacuum tubes, of approximately two kilowatt input capacity each, but as explained, the Americans have reduced the number of tubes necessary for a set from sixty to six, by increasing their capacity from two kilowatts each to twenty kilowatts each. The American metal water-cooled tube is of great advantage because it makes it possible to develop tubes of larger capacity than is possible where it is necessary to rely upon air as the only means of cooling. The building of these partially metal tubes was only accomplished as the result of American research and inventive genius which showed the way to a successful method of welding glass and copper together.

It was said that while the set in its present stage was far from being a reliable commercial transmitter, the tests just concluded show that an alternative type of equipment to the Alexanderson alternator is on the way to aid America in building up its world-wide wireless communication system. It also further substantiates Marconi's prediction that once reliable international telegraphy is established by using tubes telephony must follow in its wake.

When Dr. E. F. W. Alexanderson, Chief Engineer of the Radio Corporation of America and inventor of the Alexanderson alternator, was informed of the success of the experiment, he made the following comments over the telephone:

"Trans-Atlantic telegraphy has become a routine business, but the importance of this demonstration is the bridging of the ocean by a few powerful vacuum tube units. In this case only six tubes were used and we can safely predict that the same feat will some day be performed by a single tube. But what is the next? We have here seen a new physical principle reduced to practice on a large scale. Shall it fulfill the dreams that Edison's dynamo has not yet fulfilled to carry Niagara's power to New York? Ten years ago I became acquainted with the little device known as the Audion. Then it was a detector of signals and an amplifier, and then arose the question why not amplify some more and then some more and use it for transmitting signals as well as for receiving? Dr. Langmuir of the Research Laboratory of the General Electric Company gave the complete answer to this question, although it has taken ten years to get to the point where we have today a trans-Atlantic tube transmitter. In these ten years the energy of the vacuum tube has been increased more than a million times. A few more years of the same rate of improvement would bring us beyond our wildest dreams, but all we need to say is that science and engineering have received a new tool. It marks a turning-point like the steam engine and the dynamo. It will certainly give us trans-Atlantic telephone but it will undoubtedly give us much more."

Dr. Langmuir, when reached at his summer home at Bolton's Landing on Lake George, said, "I am greatly pleased but not surprised at the success of the tubes. It is a stepping-stone in the progress of many years' development. We will make larger tubes when larger tubes are needed and we will make them of greater efficiency for the principle on which this development has gone forward is a *sound* one."

Atwater Kent Tuner

The Atwater Kent Manufacturing Company of Philadelphia, have developed this tuner with the idea of simplifying operation and still retain maximum performance. It takes the place of a variometer and variocoupler in a coupled circuit receiver, accomplishing the results with but one adjustment.

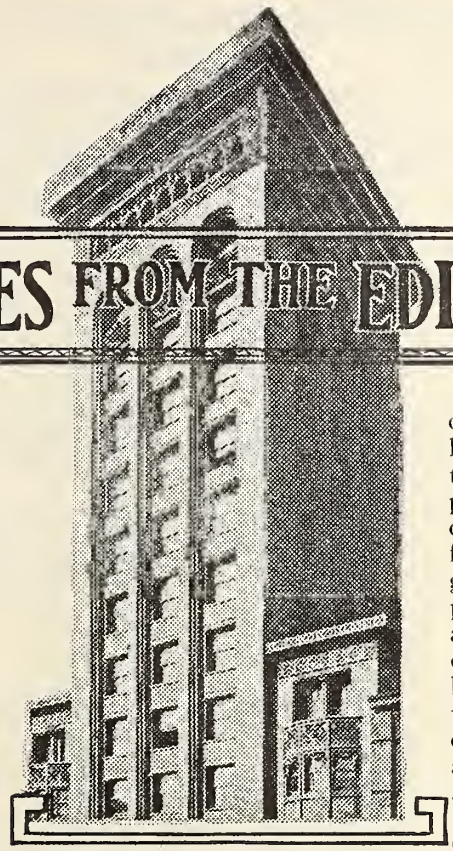
Tuning of antenna circuit is unnecessary. Three binding posts are provided on the back for adjusting the instrument to the particular type of antenna being used. Once this adjustment is determined, no further adjustment is necessary for broadcast reception.

It is absolutely unaffected by body capacity at the dial knob.

All insulating parts are sturdily made of moulded condensite and the workmanship throughout is of the highest quality.

The manufacturers state that at their summer laboratory in Kennebunkport, Maine, using this tuner, in conjunction with a standard circuit and two stages of audio frequency amplification, broadcast concerts have been clearly received from Porto Rico; Davenport, Iowa, Chicago, Ill., and many other distant points.

The instrument can be used with a crystal detector and the crystal detector later discarded when a more pretentious set is desired.



THOUGHT WAVES FROM THE EDITORIAL TOWER

1 How shall the broadcaster recover on his investment?

2 What is going to be done about interference that is ruining broadcast programs?

3 What is the public going to do about interference that threatens to make receiving sets useless?

4 What is going to be done about inducing musical artists to continue their broadcasting work?

ANSWER the foregoing questions and you have solved a mighty difficult and important problem. It is a vital problem. Radio became a craze in this country a year ago and the interest was expected to revive with the passing of the summer slump. It has revived only partially. At a recent national radio exposition, manufacturers held a meeting and told each other something had to be done.

The current issue of "Editor and Publisher" tells of a convention of newspaper circulation managers at Fresno, Calif., and the following paragraph appeared in the article:

> Use of radio as a feature of interest to the amusement-loving public was scouted as being a thing of the past by several of the delegates. It was declared that radio's sole value now is as a utility, and not as an amusement.

Newspapers have been cutting down their radio departments. In many instances this has been a blessing to the radio art. But it shows the trend of things. Radio can thrive without extravagant publicity. But it is going to the bowwows, so far as the independent broadcaster and the average receiving set owner are concerned unless there is immediate and intelligent cooperation.

There is interference between amateur senders of code messages, interference between amateurs and broadcasting stations, and interference between the broadcasting stations themselves. This is not a time to spare anybody's feelings. The truth about the whole matter is that amateurs and broadcasters have at times been too eager to use the air. Federal inspectors have failed to clear up the situation.

The question as to how the broadcaster can recover on his investment is an individual problem, affected by local conditions. The problem of interference is one, however, that can be solved with a little intelligent cooperation. The question was fully discussed at the initial meeting of the National Broadcasters' League in Chicago on October 16. One plan suggested was the arrangement of a "silent night" for broadcasters in each locality. The amateur has his distinct position and his distinct rights in radio as well as the broadcasters. He may be depended upon, of course, to make concessions to the program senders and receivers as well as to ask concessions for the code senders and receivers.

Progress of the radio business generally depends almost entirely upon the attitude of the owners of the receiving sets. Manufacturers are not going to build a market for their goods in neighborhoods where disgusted owners of sets have grown weary of trying to pick something amusing or entertaining out of an aerial bedlam.

We learn that a great many musical artists, having given their services free to broadcasting purposes for whatever publicity they could derive from it, are not so keen about continuing these gratuitous concerts. There is a notice posted in the leading Chicago Musical College: "Do not broadcast, free. Make them pay you." Who's going to pay? If the broadcasters pay, it will only be adding to their already stiff investments. Members of the broadcasting audience might be willing to pay a trifling sum for the pleasure they get from these concerts, but whom could they pay and under what conditions? Would a broadcaster be permitted under the law to accept contributions? On the other hand if the musical artist is not paid, quality of programs will be deteriorated.

Expenses of broadcasting should be paid by those who are deriving benefit from it. Manufacturers favor broadcasting because it extends the demand for their goods. Many broadcasting stations are established in the definite and generally vain, hope that the service rendered will result in orders for radio merchandise from the owner of the broadcasting station. Of course, this does not apply to the university stations, supported by state tax funds.

Rumors of plans by the Westinghouse Electric & Manufacturing Company to monopolize broadcasting in the United States seem to have some confirmation, although a statement of the committee which framed the Kellogg-White Radio Bill explicitly assured the country that no monopoly would be permitted. In this connection the following statement by H. P. Davis, Vice President of the Westinghouse Electric & Manufacturing Company, may be interesting:

"I have always maintained that, like the telephone and the telegraph, the service is inherently monopolistic in character, and to get the best results, the best programs, the greatest development, the activity should be confined to two or three companies of established reputation, having the neces-

sary facilities and incentive to develop it; that they should be under Federal control and be allowed this privilege as long as they have acceptable service."

The above statement was made in an interview sent out from the Westinghouse offices for publication. Mr. Davis went on to say that he believed five or six large, well-located and powerful stations would be sufficient to cover this continent; that these stations should be licensed that would in any way be capable of interfering with the transmission from these large stations. For local purposes there should be a network of low powered local stations on non-interfering wave bands. These stations should be capable of relaying the big stations' service for their immediate vicinity, and should be able to furnish for their locality matters of local interest."

The owner of a broadcasting station in Omaha which was put out of business on the ground that it exceeded its wave length has sued the Radio Corporation of America, charging that the big fellows are in a conspiracy and, in collusion with minor government officials, have b e e n trying to eliminate troublesome competition.

All these facts prove a necessity for cooperation and the broadcasters are to be congratulated upon having formed a League through which they can act in concert. Radio is on trial before the American public. It needs all the cooperation its friends can summon in its behalf.

Wireless for Health

Setting-up exercises by radio, beginning at 7 o'clock each morning, is the latest use to which the radio has been put. On September 5, a series of weight-reducing and weight-gaining exercises for various members of the family was inaugurated and broadcasted from the Amrad Station W G I at Medford Hillside, Mass., as a regular feature of its program.

The object of this course is to place at the disposal of all radio users the most approved methods of securing physical efficiency. Three exercise classes lasting 15 minutes each are held every morning.

While this latest use for radio is entirely an experiment, being the first time such a course has ever been attempted by radio—in fact, the first time a radio broadcast has been given at this hour of the day—reports indicate that the exercises are being tried by people all over the New England District.

The Three sets of exercises are graded as follows: The first for the normal business man or woman who wishes merely a set of toning-up exercises; the second for those who are overweight, and wish to reduce; and the third for those who are underweight and wish to build up.

New Broadcasters Licensed

Twelve licenses were issued by the Department of Commerce to 360 meter broadcasters and seven to Class B stations operating on 400 meters between October 14 and 21.

Supplemental List of Limited Commercial or Broadcasting Stations for 360 Meters, Licensed Between October 14 and 21, 1922.

Call Station

WMAY—Kingshighway, Presbyterian Church, St. Louis, Mo.

WNAT—Lennig Bros. Co., Philadelphia, Pa.

WNAH—Manhattan Radio Supply Co., Manhattan, Kansas.

WOAV—Pennsylvania National Guard, Erie, Pa.

WMAW—Wahpeton Electric Co., Wahpeton, N. D.

WTAW—Agricultural and Mechanical College of Texas, College Station, Texas.

WPAA—Anderson & Webster Elect. Co., Waco, Nebraska.

WNAJ—Benson Co., Chicago, Ill.

WMAN—Broad Street Baptist Church, Columbus, Ohio.

KFBV—Clarence O. Ford, Colorado Springs, Colo.

WMAX—K. & K. Radio Supply Co., Ann Arbor, Mich.

WSAV—Clifford W. Vick, Radio Construction Co., Houston, Texas.

The Following Class B Station Licenses Were Issued to Operate on Wave Lengths of 400 Meters, Between October 14 and 21, 1922.

Call Station

WDAF—Kansas City Star, Kansas City, Mo.

WOC—Palmer School of Chiropractic, Davenport, Iowa.

WHB—Sweeney School Co., Kansas City, Mo.

KDKA—Westinghouse Electric & Manufacturing Co., East Pittsburgh Pa.

WSB—Atlanta Journal Co., Atlanta, Ga.

WFI—Strawbridge & Clothier, Philadelphia, Pa.

WBAP—Wortham-Carter Pub. Co., The Star Telegram, Fort Worth Texas.

Three broadcasting stations were licensed during the week ending October 15: A cathedral in Boise, a college in Springfield, Ohio, and a city in California:

KFDD, St. Michaels Cathedral, Boise, Idaho.

WNAP, Wittenberg College, Springfield, Ohio.

KFEB, the City of Taft, California.

Better Field Radio

Signal Corps radio engineers are perfecting a better field radio set for Army infantry units. The present spark set, SCR 105, developed during the war has become practically obsolete and continuous-wave sets are desired.

A board of Signal Corps officers, which met at Camp Vail recently, has recommended that surplus sets such as SCR 79-A, 127 or 130 be issued to infantry regiments for training purposes until continuous-wave sets can be developed and distributed to replace the old 105s. Recently the continuous-wave sets were adopted for all Army radio communication.

The old 105 sets are quenched-spark sets used for transmitting and receiving between headquarters, usually not more than five miles apart, but, if an amplifier was employed by receiving stations, it was useful up to about thirteen miles.

The SCR-79-A, one of the sets recommended by the Board as a temporary substitute, is a vacuum-tube set designed for transmitting undamped waves and for receiving either damped or undamped signals. The transmitter delivers about ten watts to the antenna, and the messages will carry about twenty miles on waves between 500 to 1,100 meters. This set was designed for use at command posts or at headquarters where transportation is available.

Details of the new sets are not completed, but it is understood that they have a range of about ten miles, and may be used between regiments and brigade headquarters.

Bank Radio a Success

The Union Trust Company, the largest bank in Cleveland, Ohio, has inaugurated its system of broadcasting market, stock and financial reports to other banks in the Fourth Federal Reserve District. A description of the Cleveland bank's transmitting station and of its plan for broadcasting general, financial and commercial news was published in September number of Radio Age.

One of the first Ohio banks to report satisfactory operation of the service was the Citizens' Banking Co. of Sandusky. The Sandusky bank has a Grebe outfit installed by Harold Caswell.

Foreign exchange quotations are also sent daily in addition to news of the day. The local bank is equipped with printed blanks covering the various stocks and markets and the operator has only to fill in the spaces.

The Monthly Service Bulletin of the

NATIONAL BROADCASTERS' LEAGUE

Solely by, of and for Radio Broadcasting Station Owners

George S. Walker
Western Radio Corporation
President

Arthur E. Ford, E. E.
State University of Iowa
First Vice President

Frederick A. Smith
Radio Age Inc.
Secretary

Founded to promote the best interest of Radio Broadcasting stations in the United States and Canada.

Executive Offices, Garrick Building, Chicago, Ill.

New Federal Rules

Regulation 57, page 55 (Radio Communication Laws of the United States), amended August 8, 1922, to read:

Class 2.—Limited commercial stations are not open to public service and are licensed for a specific commercial service or services defined in the license. Stations of this class must not transmit to or accept public messages from other stations. No rates are authorized. Licenses of this class are required for all transmitting radio stations used for broadcasting news, concerts, lectures, and such matter. A wave length of 360 meters is authorized for such service, and a wave length of 485 meters is authorized for broadcasting crop reports and weather forecasts, provided the use of such wave lengths does not interfere with ship to shore or ship to ship service.

Class B, Radiotelephone Broadcasting Stations

A new class of radiotelephone broadcasting station license is hereby established to be known as class B.

A license will not be issued for a station in this class which does not comply in every respect with the specifications hereunder.

Specifications covering the requirements governing the construction licensing, operating and service of class B radiotelephone broadcasting stations:

Station

Wave Length.—The wave length of 400 meters only will be assigned for the use of stations of this class which must be reasonably free from harmonics.

Power.—The power supply must be dependable and nonfluctuating. The minimum required will be 500 watts in the antenna and the maximum shall not exceed 1,000 watts in the antenna.

Modulation.—The system must be so arranged as to cause the generated radio frequency current to vary accurately according to the sound impressed upon the microphone system.

Spare Parts.—Sufficient tubes and other material must be readily available to insure continuity and reliability of the announced schedule of service.

Antenna.—The antenna must be so constructed as to prevent swinging.

Signaling System.—Some dependable system must be provided for communication between the operating room and the studio.

Studio.—The radio equipment in the studio must be limited to that essential for use in the room. The room shall be so arranged as to avoid sound reverberation and to exclude external and unnecessary noises.

Service

Programs.—The programs must be carefully supervised and maintained to insure satisfactory service to the public.

Music.—Mechanically operated musical instruments may be used only in an emergency and during intermission periods in regular program.

Division of Time.—Where two or more stations of class B are licensed in the same city or locality a division of time will be required if necessary.

Forfeiture

Licenses issued for the use of the 400 meters wave length shall specifically provide that any failure to maintain the standards prescribed for such stations may result in the cancelation of the license and requiring the station to use the 360 meters wave length.

Charges Conspiracy Closed Station

BROADCASTERS throughout the country are showing keen interest in a suit filed against The Radio Corporation of America, the General Electric Company, and others, by John O. Yeiser, Jr., of Omaha, who complains that his station was closed as the result of a conspiracy.

The substance of the suit is contained in the following Associated Press dispatch, published in newspapers of the country on October 19:

Omaha, Neb., Oct. 18.—A charge that the Radio Corporation of America, the General Electric company and others have entered a conspiracy to obtain a monopoly of wireless service and prevent individual use of the radio, is made in a suit filed in United States District court today by John O. Yeiser, Jr., of Omaha, who asks an injunction to enjoin the defendents from interfering with his right to broadcast.

Yeiser alleges that "there are 25,000 wave lengths that may be used in transmitting distinct non-interfering radio service and yet the said defendants, by conspiring with unknown underlings in the department of the government, assume to exercise authority over the radio service, have crowded all broadcasting stations sending music, lectures and educational matters to waves of 360 meters."

The Radio Corporation, General Electric company, the American Telephone and Telegraph company, the Northwestern Bell Telephone company, and the Westinghouse Electric Manufacturing company and other persons and corporations unknown to Yeiser, he avers "intend to erect distinct sending stations and commercialize the same by charges for broadcasting."

He alleges his own radio station was closed recently because he was operating slightly above 360 meters wave length, and that the first amendment to the constitution which says "congress shall make no law abridging the freedom of speech or of the press," is being violated. A jury to determine damages, which he alleges to be $25,000, is requested, with treble damages under the Sherman antitrust law, and an attorney's fee of $25,000.

Yeiser's action cites that "interference was undertaken with a powerful and clear station in Atlanta, Ga., which has been giving wonderful concerts nightly, enjoyed by people in every state in the union, and to avoid conflict, was a shade above 360 meters, and in pursuance of said conspiracy a radio inspector connected with the Western Electric company, compelled said station to get back exactly to 360 meters where its efficiency is but a small part of what it would be if given an honest freedom of the air under rules that would be in no way interference to others."

Plan "Radio Week"

A National Week, to be observed from November 26 to December 2, is being urged upon manufacturers, retailers, broadcasters and the great radio public, by a group of eastern enthusiasts, who see in such a week the possibilities of mutual benefit.

The plans proposed include a variety of suggestions to make the ether of the nation throb with broadcast treats, so that radio parties may be held in the homes of the fans every night of the week. The retailers will be asked to devote more space to window displays and to other demonstrations and each of the interested groups will make it a "Boost Radio Week."

Limitations of Radio Bill

(By Washington Radio News Service.)

CONGRESSMAN White, of Maine, father of the Radio Bill, calculated to improve radio in this country commercially, in broadcasting, and for amateurs, has returned to the Capital and believes that the bill will be taken up by his committee early in December.

The enactment of this long-looked-for legislation will benefit all branches of radio, but officials of the Department of Commerce. say that it will not entirely eliminate interference in broadcasting. There are some features in connection with radio which cannot be corrected by legislation, it is pointed out by experts of the Government, such as the mastering of one's own set.

Even if there were enough waves to give each station an exclusive band, and there are not nearly enough, interference would still be encountered or at least reported by fans endeavoring to receive the news and entertainment offered by 522 stations, many of them in one community. This would be so because many receiving sets are not capable of fine adjustment and cannot be properly tuned to a specified wave length.

In spite of possessing excellent sets, many enthusiasts are not able to tune properly; they do not know how to manipulate their sets and eliminate interference within a prescribed band. Already reports have been received by the Department that broadcasting on the new 400 meter wave is interfering with that on the 360 wave, which should not be the case with 40 meters between.

If transmission is good, first-class receiving sets should be capable of tuning within a variation of from 5 to 10 meters, inspectors say; unless one station broadcasting was in the immediate vicinity of the receiver.

Although Secretary Hoover will probably receive authority in the Radio Bill to limit the number of transmitting stations, it will be difficult to accomplish this in congested areas where several broadcasting stations are already located. Municipal authorities and organizations of listeners-in may have to aid the Secretary when the time comes by indicating which stations are the best and what services are most desired. The listeners-in are organized in Washington and such a body might become a censor of the air, so to speak, endorsing the good stations and reporting those which are unsatisfactory, thus aiding in establishing better service. In any event, it is hoped that both wave lengths and time schedules will aid the broadcasting in congested districts.

Distributors of radio equipment capable of fine adjustment should instruct purchasers carefully and when possible assist them in setting up their sets and tuning in. It is evident that a large percentage of those interested in radio will have to be educated in the use of their sets, and this may devolve upon the broadcasters themselves, who are interested in having their programs clearly heard, or on radio associations. The Bureau of Standards has been giving information along this line for some time.

It is expected by Department of Commerce experts that the loop receiver, possessing directional qualities, will aid in the selection of broadcasts and help in eliminating the other stations' programs, when used in conjunction with tube receiving sets. The cost is not excessive in comparison to an aerial and as the indoor coil can be installed in a corner of a room, the disfiguring overhead aerial may eventually disappear from housetops. It is part of the question of experimentation and education in radio.

Appeals to Hoover

AMONG other interesting developments of the month relating to broadcasting and to the growing impression that the very life of radio is menaced by interference in the air and by lack of cooperation between the government and the radio broadcasters and listeners-in, was a letter addressed to Herbert Hoover, Secretary of Commerce by William B. Duck.

The letter follows:

September 29, 1922.

Mr. Herbert Hoover,
Secretary of Commerce,
Washington, D. C.

Dear Sir:

Can you not, Mr. Hoover, at once assume the initiative and end the intolerable existing situation on radio by reason of the existing order that all broadcasting be done on 360 meters? The business of every radio house has suffered incalculably and at a time when they could ill afford to stand the strain, because of this unnecessary situation. We have been patient, hoping and hoping that the law would quickly be changed. Had the contemplated law been passed a few months ago the radio business would have been wonderful and none of us would have had to endure the financial strain that we have endured this summer. To me it is utterly inexcusable that an intelligent body of men would allow such a condition to exist for such an unreasonable length of time. I know all the alibis and, to be frank, they mean nothing. It would not take five minutes to put this law through.

Why, then, should we be compelled to wait month after month until the endless debates on tariff, bonus and other matters have had their run? You have stated under your signature that everyone is in favor of the law because no one is interested in disturbances. The Government was quick to take measures to stop the stress of the coal and railroad strikes and yet it deliberately punishes all radio manufacturers and causes unnecessary disturbances to a million people by allotting a pin point in the Heavens for the broadcasting of radio entertainments.

I am a lawyer by profession and in the course of my studies I have familiarized myself with much that has taken place in Congress for a long number of years but there is nothing in the entire history of the proceedings of Congress remotely approaching the indifference that has been manifested on a matter so urgent and vital and yet so simple to remedy. I do not believe that there would be a single objection when a proper explanation is made for immediate action on the bill now pending.

If there is some good reason for not passing the bill in its entirety, it would be no trouble at all to pass a bill covering that feature only which would permit broadcasting on different wave lengths. In fact, I do not believe that any law is necessary to change the existing conditions. I do not believe that any bill was passed giving the Department of Commerce authority to assign wave lengths of 360 meters for broadcasting, although I may be mistaken in this. I am certain that no bill was passed for the recent ruling assigning wave lengths of 400 meters for the more powerful stations. I cannot help but remark that this latest ruling has not benefited the situation a whole lot. There are wonderful concerts going on in every part of the country every evening and also many instructive talks. The grand opera season will soon open in Chicago. Here in Toledo we can hear no station but Detroit between seven and ten o'clock except when using an extremely selective set and then not clearly.

We criticize the existing conditions in Russia and yet we have a parallel case in the ether in this country and those in authority are responsible for it.

It has always been my understanding that you are one of the few men in this blessed country of ours that does things and without a whole lot of red tape. You can make yourself the eternal benefactor of a million fans and the radio manufacturers and dealers by taking the initiative in this matter. Will you not do it? There is no excuse for the existing conditions to continue for another week.

I sincerely trust that you will use the power and authority vested in you to remedy this situation without delay

THE WILLIAM B. DUCK CO.
Per William B. Duck.

With the Radio Trade

Business Situation

Conditions forecast revival of public interest in radio and a consequent boom in the industry was the consensus of radio broadcasters of the country, who met at the Hotel Sherman, Chicago, October 16, to organize the National Broadcasters' League for the protection of their interests.

The gathering of radio men was somewhat startled by the straight-from-the-shoulder announcement of George S. Walker, President of the Western Radio Corporation, of Denver, who also operates broadcasting station WFAF, that 5,000 radio dealers are on the verge of bankruptcy and that something must be done to readjust conditions in the industry to save this small army of business men from the loss of their investment.

This statement aroused the conferees to a realization of the situation in the industry and brought out an expression of belief that the first of the year would see a renewed interest in radio by the public and the movement of radio supplies from the dealers' shelves. Mr. Walker made it clear that he did not wish to be mistaken for a pessimist. He is convinced that the radio industry is destined to become one of the greatest commercial enterprises in the world, but he insisted that the proper type of men should steer the radio ship, and the industry as a whole should be foremost in their minds and not permit the selfish interests of a few to guide an infant industry, with the risk of running the bark on commercial shoals that might spell its destruction when it has such a bright future.

The majority of the delegates to the meeting were optimistic of the future of radio and expressed themselves as confident that in January there would be a fresh spurt in all lines of the industry. One of those who emphasized this point was Thomas Findley, of Minneapolis, of the Findley Electric Company, who operates Broadcasting station WLAG.

This feeling of optimism confirmed the decision of Milo E. Westbrooke, who attended the conference, made after the First National Radio Exposition last June, that January was the proper time to hold the Second National Radio show, which will be in the First Regiment Armory, Chicago, January 13 to 20. By that time the school boys will have got well into their radio work in the school shops, the radio fans will be spending more time home at nights, the reception will be at its best and the dealers will have completed their inventories and know where they stand and what they want to buy.

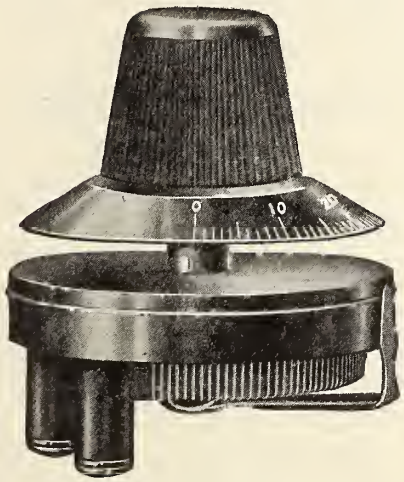
Plans are complete for the First Annual South Eastern Radio Exposition to be held in Atlanta, December 4 to 9, inclusive.

This exposition is sponsored by leading radio jobbers and dealers of Atlanta and the southeast, and undoubtedly will create a marked increase in radio activity.

New Klosner Devices

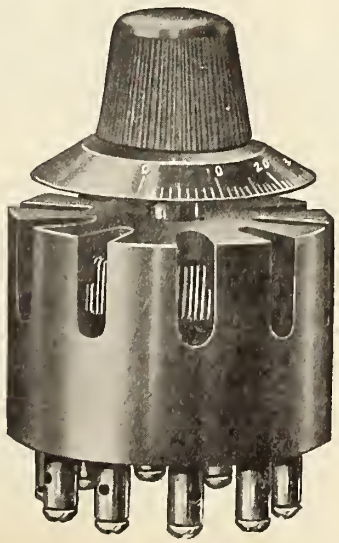
The Klosner Improved Apparatus Company has recently announced to the radio world the introduction of its two new pieces of apparatus, Klosner Vernier Rheostat Model 200 and the Klosner Amplitrol.

The new rheostat is claimed to be far ahead of all other instruments for controlling detector tubes. It has a vernier micrometer adjustment, which makes it several times more sensitive than any ordinary rheostat. It permits getting exactly on the correct spot for loudest reception of speech and code.



It is made of genuine condensite, with phosphor bronze contacts. It is equipped with a dial on which graduations are shown in white. Both course and fine adjustments are operated by one single knob.

The Klosner Amplitrol fills that long-felt radio want—of controlling the vacuum tube circuit without the use of jacks, plugs or additional switches. With the amplitrol in use, it is no longer necessary to plug in from one stage to the next. The phones or loudspeaker are simply attached to binding posts and any stage is turned on at will.



The amplitrol not only adjusts the filament to its maximum efficiency, but it also automatically switches on and off the plate circuit. Unlike automatic filament control, the amplitrol does not put a sudden strain on the filament. It provides a gradual current increase for the filament, prolonging the life of the vacuum tube at least one-third.

It is made of moulded condensite with phosphor bronze contacts. Its exposed metal parts are highly nickel plated. It has a new style knob and dial with graduations in white lettering.

New York Show Dec. 21

Announcement has just been made that with the backing of the more important interests in the radio industry, the American Radio Exposition will be held in Grand Central Palace, December 21 to 30, next. It is planned to make this the first really comprehensive radio exposition ever staged and all manner of inventions, equipment and accessories connected with wireless transmission will be exhibited. The exposition has been officially indorsed by the Associated Manufacturers of Electrical Supplies, and the National Radio Chamber of Commerce, both organizations promising their utmost cooperation in order to insure the event being a credit to the industry.

It is the intention of the sponsors of the exposition, the American Radio Exposition Company, to make the event a display that will cover the entire radio field. The reason the exposition company chose the holiday season for holding the show is that the schools and colleges will be closed, thus offering an excellent opportunity for students, parents and teachers to learn the real value of and the progress made in wireless during the past few years.

Another New York Show

All the latest wonders of the Radio industry will be shown, when radio manufacturers from all over the world will assemble during the week of November 20 to 25, at Madison Square Garden, New York, to stage the greatest exhibition of radio ever held. The scope of the show will be international as exhibitors will bring products of both foreign and American ingenuity before the public, showing the tremendous strides that have been made in the art since broadcasting became popular.

Some of the stellar features announced for the show include the transmission of photographs by radio, the drilling of an entire army by the same method, whispered conversations to be carried on between the Madison Square Tower and Eiffel Tower in Paris, moving pictures showing how radio can be used in place of an anaesthetic during an operation and radio talking pictures.

Pick-Up Records By Our Readers

REMARKABLE success with a Reinartz circuit as described in RADIO AGE is reported by George J. Besnah, 620 Elk St., Stevens Point, Wis. Mr. Besnah, who is associated with the St. Paul Railroad, made a Reinartz set with two steps of amplification with which he has been able to hear such distant stations as KUO, San Francisco; CJNC, Winnipeg, Manitoba, Canada; KZN, Salt Lake City, Utah; WBZ, Medford Hillside, Mass.; the station at Galveston, Texas, and WSB at Atlanta.

Mr. Besnah writes to Mr. Pearne, technical editor of RADIO AGE, as follows:

"Last June I constructed a Reinartz set as per your diagram and have had excellent results with it. I don't think you will find many records that will beat mine. I have two stages of amplification, but seldom use more than one. I heard WAAJ, Boston, Mass., very clearly on the night of July 26. This was in extremely hot weather and static very bad, but I got them in very well on one stage.

"I note your article in September issue of RADIO AGE, saying this set should have a radius of 1,500 miles in winter. In September I heard KUO, San Francisco, Calif., fine, using one stage. This is about 1,900 miles. I live in the geographical center of Wisconsin. Have reached Boston on the East Coast, San Francisco on the West; Galveston on the Gulf and Winnipeg, Manitoba, on the North. Please advise where else you want me to go and I think I can make it. I have an aerial 150 feet long; two wires about 45 feet high. This set was hurriedly constructed to try out this circuit. It is mounted on a wood panel; inside wiring No. 18 bell wire. Not a soldered connection in the outfit. Am sending you a list of some of the places heard, of which I have kept a record. I want to thank you for your very instructive articles and information sent me and your advice to the amateur to build a Reinartz set is a tip they will not regret they followed. Knowing what my outfit will do and has done I wouldn't trade the old pine box for the finest set the radio shops exhibit.

Again thanking you, I am

Very truly yours,

GEO. J. BESNAH.

620 Elk St., Stevens Point, Wis.

Following is a list of stations heard by Mr. Besnah:

KDKA, Pittsburgh, Pa.; KSD, St. Louis, Mo.; KUO, San Francisco, Calif.; KYW, Chicago, Ill.; WDAP, Chicago, Ill.; WGAS, Chicago, Ill.; KZN, Salt Lake City, Utah; WAAJ, Boston, Mass.; WAAK, Milwaukee, Wis.; WCAY, Milwaukee, Wis.; WAAL, Minneapolis, Minn.; WBAD, Minneapolis, Minn.; WLB, Minneapolis, Minn.; WAAP, Wichita, Kans.; WWJ, Detroit, Mich.; WCX, Detroit, Mich.; WDAF, Kansas City, Mo.; WOQ, Kansas City, Mo.; WHB, Kansas City, Mo.; WFAA, Dallas, Texas; WFAS, Fort Wayne, Ind.; WGAB, Houston, Texas; WGAQ,Shreveport, La.; WGAY, Madison, Wis.; WHA, Madison, Wis.; WGF, Des Moines, Iowa; WGR, Buffalo, N. Y.; WGY, Schenectady, N. Y.; WHAA, Iowa City, Iowa; WHAB, Galveston, Texas; WHAJ, Bluefield, W. Va.; WHAS, Louisville, Ky.; WLW, Cincinnati, Ohio; WOC, Davenport, Iowa; WOH, Indianapolis, Ind.; WOI, Ames, Iowa, WOS, Jefferson, Mo.; WPA, Fort Worth, Texas; WSB, Atlanta, Ga.; WLAD, Hastings, Nebr.; DN4, Denver, Colo.; DO5, Denver, Colo.; KFAF, Denver, Colo.; CJNC, Winnipeg, Man.; WBL, Anthony, Kans.; WMAK, Lockport, N. Y.; WLAM, Springfield, Ohio.

6,000 Miles With Crystal Set

"Fort Stockton, Texas,
October 5, 1922.

"Western Radio Corporation,
"Denver, Colorado.

"Gentlemen:

"Last evening, (Oct. 4,)about 10 o'clock p. m. (Central time), using a small, home made loos coupler, with ordinary crystal hook-up, no accessories whatever, in the way of amplification, I very plainly and distinctly heard you giving the list of persons that heard you broadcasting, and your invitation for all to write, in order that you might judge how it was going out.

"Now, as I have contended for some time, this dope you see in some radio journals, that the range of an ordinary crystal receiving set is not over 100 miles or so, is all bunk.

"If a person has a properly designed set, and has a first class ground, with all soldered connections, a good head set, and last but by no means least, a first class crystal, and knows how to tune them in, there is no telling what the range is.

"I have often heard Honolulu at this place air line distance 3,300 miles, in fact used to hear him every night in the winter of 1920, when he was using 9,000 meter spark, with an ordinary crystal hook-up, but of course using a larger tuner.

"Last night I not only heard you plainly, but also heard San Antonio, Texas, Fort Worth, Texas, and the St. Louis Post Dispatch, and all came in very distinctly and plain.

"If you give this out in your broadcast, be sure to state that the reception was with an ordinary crystal hook-up, and that the crystal used was the M. P. M. (Million Point Mineral), which, by the way, is away ahead of any crystal I have ever tried.

"Yours truly,

"GEO. C. HASELTINE.

"Address: Geo. C. Haseltine, Fort Stockton, Texas.

Crystal Scores Again

St. Louis, October 2, 1922.

Radio Age,
Garrick Building, Chicago, Ill.

Gentlemen:

In May I received a thirteen contact point crystal set from you as a subscription premium. My set is doing such good work that I have decided to send you the records I have received.

On Friday, September 29, I tuned in with WGY and the Kansas City Star; on September 30, Rochester, N. Y., and on October, WOC, Davenport, Iowa.

I have just used the crystal set alone without batteries or 2-stage amplifier. My aerial is about 100 feet long and lead-in is about twenty-five feet.

I receive Stations KSD and WCK so distinctly that I can hear it in all parts of the room, in which I have my set installed. Yours truly,

EDW. J. REBRICK,
1406 N. 12th St.

Back Home Concert

Down in Johnson City, Tenn., arrangements were made last week for a radio concert. This was to be "staged" in the store of the Bishop Electric Company, radio dealers, of that city. It was suggested that it would be interesting to have "home town" girls take part in the concert to be received, and in order to satisfy the desires of the many persons who had been invited to attend the concert, the Crosley Manufacturing Company, Cincinnati, Ohio, broadcast a special concert in which Miss Edith Miller, violinist, Miss Marjory Hunt, pianist, and Miss Lowell Jones, all of Johnson City, took part. The three young ladies are studying music at the Cincinnati Conservatory of Music, and by special permission of the faculty of that institution came to the broadcasting station, the call letters of which are WLW, and played for the folks "back home." And when this special concert was being broadcast the following telegram was received from the Bishop Electric Company: "Big crowd in store enjoying work of Johnson City girls."

Long Distance Record

Summer static didn't bother the radio operator on the tug Oneonta, which was anchored at Columbia river harbor, Astoria, Ore., when he heard Atlanta recently. This is a distance of about 2,400 miles. It is considered a record in radio telephony and is the more interesting in that it was made during warm weather.

Forty-six States in Line

There are at present only two states in the union, Delaware and Wyoming, which do not have broadcasting stations. Kentucky and Mississippi went on the broadcasting map of the department of commerce last week, when stations in Louisville and Corinth were licensed.

Questions and Answers

P. S., Brookline, Mass.

Question: I read your article on the Reinartz tuner and then saw in another magazine, another type of coil. This was wound on a 5-inch tube, with the same number of turns and the taps were taken off at the same places. Could you tell me the difference in inductance? In the October issue of Radio Age, you recommended a "T" type antenna for transmitting. I am using a cage type at present. Is there any difference in efficiency?

Answer: The tube winding is quite often used, although Mr. Reinartz only recommends it for 600 meters and over. In the spider-web type a closer coupling is obtained and the distributed capacitance is reduced to a minimum. If your lead-in is taken off from the center of your antenna, you will probably get better results with the cage type.

M. I., Stoughton, Wis.

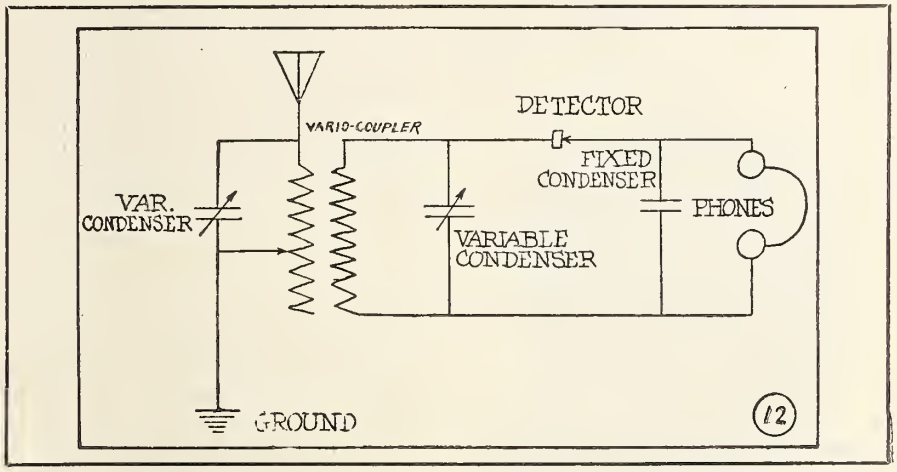
Question: How could I arrange an amplifier or loud speaker so that instead of putting my phones to the ear, it could be put under an amplifier and speak loudly out into the room, so that all present could hear what goes through the connecting phone? Please give me the name and address of a good radio book, from which to read up on radio.

Answer: I do not exactly understand what you mean. If you want a horn to which your phones can be attached, you can procure this at any radio supply house. There are many types on the market. The Wireless Experimenter's Manual, by Elmer E. Bucher, is a good book for you and any book store can get it. It is published by the Wireless Press Inc., 326 Broadway, N. Y.

G. B., Indianapolis, Ind.

Question: I am interested in the Reinartz receiving set. Can such a tuner be used on a crystal set? What is the wave length of the set described? Could this wave length be increased by using honey-comb coils? When you speak of "signals" do you mean music or just C. W. telegraph.

Answer: No. it would not work. Wave length is 130 to 370 meters. Honeycomb coils added to this will increase the wave length. The term signals as used in this case means music, voice or C. W.



L. R. S., Toledo, Ohio.

Question: Will you please give me a good circuit using a vario-coupler, two variometers, detector tube and batteries. I have tried several circuits, but have had poor success, so please send me a good one, or print it in your question and answer column.

Answer: Circuit below.

H. T. W., Middletown, Ohio.

Question: Will you kindly send me details showing how to hook-up vacuum tube to the crystal set circuit enclosed? I would like to have the crystal taken off if possible.

Answer: I am sending this circuit by mail.

E. A. T., South Haven, Mich.

Question: I am a subscriber to Radio Age and would like to receive the following information. Will you please send me a drawing for a good radiophone hook-up, using four C.302 tubes, with voice amplifier? I will use motor generator for plate supply. If possible would like to have all choke coils, etc., described, giving length, number of turns with size of wire used.

Answer: I am enclosing circuit in the mail, but as I have never had any personal experience with this circuit, I cannot give an intelligent description of the coils, but you can soon determine this by experiment.

G. E. McG., Cedar Rapids, Iowa.

Question: Please inform me as to the best method of connecting up a crystal receiving set using a vario-coupler and a variable condenser. I have a good aerial, I think. It is 150 feet long, consists of 3 wires well insulated, and is 40 feet high. Would this be considered a good aerial?

Answer: Hook-up above. Your aerial ought to get splendid results.

W. A. R., Chicago, Ill.

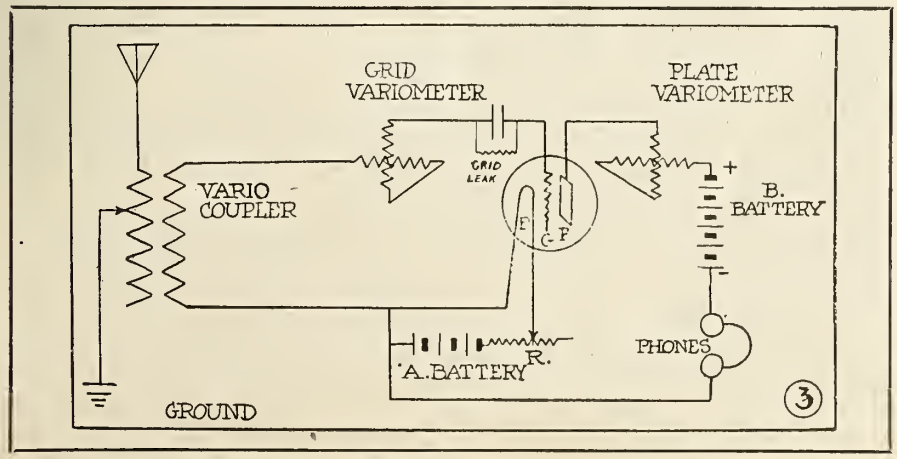
Question: Although an amateur, I read with great interest in the September issue of the Radio Age, your article on, and hook-up of the Reinartz tuner. I mean to get busy immediately on one of these and surely would appreciate it if you would please send me a diagram showing how instruments, switches, control, etc., are placed in box and on panel 8" by 18". Also the kind of bulb used. Will you also please give me a circuit for a sharp, long distance crystal set?

Answer: I am sending you a rough sketch by mail, showing how the panel is arranged, etc. Also I am sending the crystal circuit. Use either Cunningham, Radiotron, or Western Electric tubes. Be sure that you get a detector tube for the detector and amplifying tubes for amplifiers.

E. K., Chicago, Ill.

Question: I have read with interest your article on how to make an audio frequency transformer and would like to know if it is possible to make this transformer and have it work, without a great amount of leakage. Is it possible to calculate the transformer, or is it just experiment? I expect to construct one of them. If silicon steel can not be purchased, what other electrical sheet iron can be used, and where can I purchase that, or silicon steel?

Answer: If the transformer is well made, there will be no leakage to speak of. All joints where the iron comes together should be nice and square, so that they will make good contact. Yes, all transformers are calculated. This particular one has been made and tried out and is not an experiment. You can purchase the iron or steel from Jos. T. Ryerson and Sons, Chicago, Steel Sales Co., Chicago, or Chas. G. Stevens, Chicago. Use either silicon steel, or electrical sheet iron.



U. S. Sells by Radio

Tipping off American business men by radio as to foreign sales openings in order to get the jump on America's competitors for the world markets is the commerce department's latest trade-promoting stunt.

Inquiries for American goods coming into the bureau of foreign and domestic commerce from consuls, commercial attaches and other government representatives in foreign countries are now distributed to New England manufacturers and merchants through the air by the bureau's Boston office in collaboration with the WGI broadcasting station at Medford.

The service was tried out one night last week for the first time as an experiment. By first mail the next morning several letters were received from nearby firms. One of the leading New England manufacturers of artificial leather who happened to be "listening in" that night learned of two openings for his goods; one in Mexico and the other in Colombia. He was much pleased, commending the department of commerce for taking advantage of "this most valuable time-saving device." In the opinion of another New England merchant, the new "sell-it-by-air service" should appeal particularly to the out-of-town manufacturers and merchants who are not in daily contact with the offices maintained by the commerce department in Boston, New York, San Francisco, Chicago, New Orleans and other leading cities. "For example," says this executive, "there are many manufacturers interested in radio who wish to sell abroad but who are prevented from keeping in constant touch by frequent visits and telephone calls with the trade openings reported to the government agents. As the radio stations reach many outlying cities it would seem that this service would be of especial value to more distantly situated business men within a wide radius."

Selling American goods in foreign markets through the help of ether waves can be readily extended to other parts of the United States, in the opinion of Dr. Julius Klein, director of the bureau of foreign and domestic commerce. Director Klein pointed out that his bureau maintains thirty-four district and cooperative offices in this country in addition to the Eastern branch. The sending out of the information in each case is a problem for the local manager to arrange with some nearby broadcasting station, as all of them have been authorized to undertake the work, he said.

Radio to Near East

By CARL H. BUTMAN

Special to Radio Age:

Washington, D. C.—Back of the commercial systems of world communication, known and used by both the Government and private interests, lie existing lines of communication little known to the public, although not strictly "secret." Only recently, when the "Terrible Turks" threatened the Dardanelles and southeastern Europe, the State Department asked the Navy if aid could be given in the transmission of dispatches to the Near East in the event that communication service to that quarter of the globe was broken. To this question, which caused the State Department some concern, the Naval Communications Service made reply as follows: "Our lines of communication to the Embassy at Constantinople and all our naval craft in Turkish waters are established and in official use today. We can communicate with Admiral Bristol within a few minutes."

It has justly been stated that naval communication circles the world. So it does, with the exception of very few corners, and three-fourths of the communication is handled by radio.

How the Service Operates

Today, when a dispatch for Admiral Bristol is filed in the Navy Department, it goes out at once via the Annapolis radio station to a French radio station, thence by land line to the office of the American Communication Service operated by naval personnel in Paris, where it is checked and forwarded by wire to Coblenz. The message is relayed electrically at Coblenz from the office of the chief signal officer of the American Forces in Germany, where Army operators handle the wires to Vienna. The Vienna station is in the Austrian Telegraph building, but the station is operated by the United States Navy. From Vienna the message goes forward by Naval radio service from the station at Laareburg direct to the receiving station at the American Embassy at Constantinople, where naval personnel again handle the dispatch and forward it to the naval ship on station there, which relays it to its destination.

Admiral Bristol is in charge of all American naval vessels in Turkish waters, and the presence of his destroyers makes a sort of fan to all points of which messages can be relayed by radio and delivered from the vessels to other points, In the event of a break in the wires from Paris to Vienna, messages for Constantinople would be radioed by French stations to Vienna and to United States naval vessels in the Mediterranean.

The Return Route

The route of messages from points in the Black Sea to the United States is similar, except that the outlying ship transmits by radio to Constantinople, either to the station ship or the Embassy, but only the ship can send messages. From the station ship the message goes by radio to Vienna, thence to Coblenz by wire and through to Paris, where dispatches are turned over to French Radio Service for transmission, either from Lyons or Lafayette to Bar Harbor and delivered by land wire to the Navy Building in Washington.

This system, though seemingly somewhat round-about, is nearly direct and is good except that it is subject to delay on account of schedules, as the Allies all use the same route in and out of Constantinople and keep it busy twenty-four hours of the day.

Radio Cheers Convict

When George Rollins, convicted of murder, was "listening-in" on his little radio set several weeks ago, he heard information which may bring about his pardon. Rollins in his cell was listening to the regular late news broadcast from the Amrad Station WGI at Medford Hillside. Announcement was made that Governor Sproul of Pennsylvania was to release Frank Smith, alias Jesse Murphy, who confessed some months ago to one of the two murders of which Rollins was convicted. The two killings occurred in February, 1917, for which no one has yet paid the penalty. Rollins and his brother, Charles, were both implicated and convicted. While George was awaiting sentence, Murphy, down in Pennsylvania, confessed to one of the murders. While he did not confess to the killing with which George Rollins is convicted, he has positively stated that Rollins did not do it, and that he, Murphy, knows who did.

Naturally, George Rollins secured a new lease on life when he heard the news by radio that Murphy was about to be released from the Philadelphia Penitentiary and would be brought to justice in Boston. Boston officials have gone to Philadelphia to apprehend Murphy and bring him to Massachusetts.

This is probably the first instance of its kind on record when a convicted life prisoner heard information by radio that will probably bring his freedom.

New Crystal Holder

Michael Maltz, of the Radiall Electric Co., Passaic, N. J., has developed a new method of mounting crystals. The crystal is fastened into the cup with a conducting cement. The cement has the virtue of being less expensive and the crystal is not subject to heat.

Photo-Electric Detector Tubes

(Continued from page 7)

to the fact that these photo-electric or alkali vapor tubes operate best at a lower filament temperature than do the gas content tubes should make them more economical and easier to operate for the average user. The writers were also surprised to find that these tubes function admirably as amplifiers with 10 volts on the plate giving distortionless amplification of speech and having very high amplification factors.

The writers feel sure that the cost of manufacturing will not be materially greater than for the vacuum tubes now in use. The alkali is distilled over into the tube during the evacuation process until a thin silver deposit appears on the tube walls. Space does not permit an explanation of the manner in which this is accomplished.

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Chicago, Ill.

Design of Portable Wavemeter

(Continued from page 9)

construction of a wavemeter suitable for the measurement of frequencies from about 3,000 kilocycles per second to 530 kilocycles per second (Wave length from 100 to 570 meters).

The parts of a wavemeter are usually: a variable condenser, a fixed inductance coil, and a device to indicate current flow. The condenser will first be considered.

It will be well at the start to eliminate certain large classes of condensers whose construction make them unfit for use in wavemeter circuits. Variable condensers employing other dielectrics than air, and condensers whose capacities are varied by a screw to change the distance between plates, however serviceable they may be for furnishing a variable capacity, will not in general retain their calibration and are therefore untrustworthy for use in a wavemeter. This elimination leaves only air condensers whose capacity is varied by changing the overlapping area of parallel plates, the usual type of variable condenser. All condensers of this type can by no means be used in wavemeters.

A condenser to be used in a wavemeter should have fairly heavy plates rigidly held together with ample tie rods and nuts, spacing washers of large diameter and sufficient thickness, adequate conical bearings, and, preferably, unimpeded rotation through 360 degrees of arc. Particulars in which variable condensers commonly fail to meet these and other requirements are: Too thin plates, spring-supported bearings, extremely close spacing of plates, vertical or lateral play of the shaft in its bearings, contacts made by brushes wiping on movable parts, stops which in arresting the rotating plates shift them out of line, shifting scales or indices, and faulty workmanship which allows short-circuiting of the condenser at some settings. In general, anything that allows a capacity change without a change in scale reading or a change in reading without a capacity change destroys the usefulness of a condenser for wavemeter purposes. Some method of shielding is desirable to eliminate any change of condenser capacity owing to movements of surrounding bodies. The shield usually is a grounded metal

(Continued on next page)

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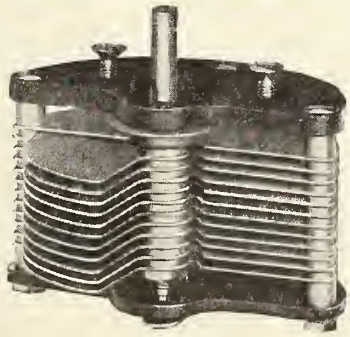
"United" Audio Frequency Transformers

The beauty of the outside of this transformer is but a reflection of the superb workmanship under the shell—no howling—no distortion—clear amplification for one or more stages.

"United" Variable Condensers



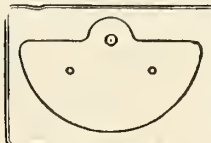
Prices

43 plate	$4.50
23 plate	4.00
11 plate	3.50
5 plate	2.75
3 plate	2.25

without dial or knob

That "United" Condensers have become the standard with manufacturers of radio sets, by which all others are judged, is, in itself, the strongest endorsement of their superior construction and effectiveness.

Ask your dealer to show you this condenser —then you, too, will appreciate why it has been accepted as the standard.



Mounting made easy by our template for locating panel holes; free with each condenser.

NOTE

Any advertised claim of having an arrangement with us to sell our products at special prices, is fraudulent.

United Mfg. & Distributing Co.

536 Lake Shore Drive, Chicago.

case placed around the condenser.

The inductance coils will next be discussed. The requirements of a wavemeter coil are: (1) That its inductance be such that with the condenser used the desired range of wave frequency can be covered; (2) that its effective resistance and effective capacity be low; (3) that its inductance, resistance, and capacity all be constant.

The first requirement, which has to do with the range of wave frequencies, will first be considered. It is well to restrict the part of the condenser scale used for frequency measurements to the sector between 15° and 170° on a scale graduated in degrees, or between the eighth division and ninety-fifth division on a scale graduated in hundredths. Since the capacity at 170° or 95 hundredths will almost always be more than six times the capacity at 15° or 8 hundredths, the frequency obtained with any one coil at the lower end of this region will be not less than about two and one-half times the frequency obtained with the same coil at the upper end. This will make it possible with one coil to cover the range from 3,000 to 1,200 kilocycles per second (100 to 250 meters) and with a second coil to cover the range from 1,330 to 530 kilocycles per second (from 225 to 570 meters).

The following table gives the number of turns required for two single-layer inductance coils which will cover approximately the stated ranges with each of the maximum capacities indicated in the table. It will be noted that the size of the wire and the spacing between turns are not specified. The inductance is nearly independent of the size of wire used, and the spacing is controlled by the number of turns and the length of the inductance coil, both of which are given. The length of the coil, as indicated, is the length of the actual winding, not the length of the supporting core.

Single-Layer Inductance Coils for Short-Wave Portable Wavemeter.

Coil 1, Range 3000-1200 kilocycles per second (100-250 meters) Diameter, 10 cm. (4 inches); length of winding, 2.5 cm. (1 inch).

Maximum capacity of condenser	Number of turns
0.0005 microfarad	16
0.0007 microfarad	13
0.0010 microfarad	11

Coil 2, Range 1330-530 kilocycles per second (225-570 meters) Diameter, 10 cm. (4 inches); length of winding, 5 cm. (2 inches).

Maximum capacity of condenser	Number of turns
0.0005 microfarad	42
0.0007 microfarad	35
0.0010 microfarad	30

The second requirement stated for the coil was that the effective resistance and the effective capacity be low. Low resistance is desirable in order to secure sharper indication of resonance. There are several reasons for keeping the effective capacity low. This capacity serves to increase the total capacity of the circuit. This increase will be only a small part of the total capacity at the high-capacity end of the condenser scale and hence will not appreciably help in extending the frequency range downward, but it may be a considerable part of the capacity at the low-capacity end of the condenser scale and may seriously limit the upward extension of the frequency range. Another and more serious objection to a large effective capacity is that this capacity is always to a greater or less extent subject to variation as a result of change in the surroundings of the coil. Since this capacity can not be controlled, it should be, as far as possible, reduced.

The practice of surrounding an inductance coil with quantities of miscellaneous insulating material is undesirable in any radio circuit and is especially to be avoided in the case of wavemeter coils. Imperfect insulating materials so used increase not only the effective capacity but also the effective resistance of the coil. This does not mean that all types of manufactured insulating materials are unsuitable for use in frames for wavemeter coils. Probably, however, the best form on which to wind the coil of a wavemeter like that here described is a hollow spool of thoroughly dry wood lightly varnished with an extra grade of insulating varnish. The use of shellac is not considered advisable under any circumstances. The use of wood having even a comparatively small moisture content may seriously affect the accuracy of the wavemeter. Properly selected wood is chosen in preference to manufactured insulating materials, glass, or paste-board. Many available manufactured insulating materials largely increase both the resistance and the capacity of the coil. While the electrical properties of glass make it well suited for a form, it presents too great mechanical difficulties. Paste-board is not rigid enough and should not be used under any circumstances.

The wire used may be solid copper double cotton covered, No. 24 B & S or larger. The wire should be lightly varnished with a single coat of an extra grade of insulating varnish. Further insulation merely increases the effective resistance and capacity of the coil without compensating advantages. The resistance can often be considerably reduced by the use of braided high-frequency cable. Care must be taken, however, in using the high-frequency conductor to see that all the strands are continuous and well insulated from each other and that every strand is joined at the terminals of the coil. If imperfect insulation exists between adjacent strands, these high-resistance contacts may cause a considerable increase in the power losses. Broken strands seriously increase both the effective capacity and the resistance of the coil. The strands may be tested for continuity by dipping one end of the cable in mercury and joining the separate strands at the other end successively to a buzzer or voltmeter joined to a battery, the circuit being closed through the mercury contact. The enamel may be removed from the ends of the separate strands by carefully heating the end of the wire cable to a red heat and dipping it in alcohol. This procedure makes the strands more fragile and consequently particular care must be exercised to avoid breaking them.

A single-layer coil has generally a lower effective capacity than a multi-layer coil of the same inductance and radius. This, together with the greater precision with which specifications can be furnished for winding single-layer coils, was the reason for choosing this type of coil in the table already given. Since appreciable effective capacities exist when there are parts of the circuit near each other which have comparatively large areas and which are at different potentials, it follows that the leads from the coil to the condenser should not be long or close together. An additional reason for having the leads short is found in the third requirement previously stated for a wavemeter coil, namely, that the inductance, capacity, and resistance of the coil, including its leads, be kept constant. Long leads are apt to be flexible; and flexible leads, long or short, introduce possibilities of change in inductance, capacity and resistance which can not be compensated for by any slight advantage they may give in convenience of handling. The best leads are rigid metal terminals soldered to the ends of the wire and screwed to the wooden core. The position of the coil should be such that the plane of the turns of the coil is perpendicular to the condenser plates if the condenser is unshielded. This is to prevent the induced current in the coil from itself inducing eddy currents in the condenser plates. Since it is almost always desired for convenience in coupling to have the plane of the coil vertical and the condenser plates horizontal, this matter will usually take care of itself. A very important precaution in giving the coil permanent characteristics is to draw all the turns tight and so fasten them that with ordinary care in handling they will not shift.

The coils may be attached to binding posts on the wavemeter, so that they may be conveniently connected or removed. Various other methods of attaching may also be used.

The third part of the wavemeter is the device which shows current flow and thus indicates resonance. If a crystal detector and telephone receivers are used, only the one-point (unilateral) connection should be employed; that is, the detector and telephone receivers are joined in a closed circuit, and one point of this circuit is joined to one terminal of the coil. This arrangement is sufficiently sensitive and makes the calibration of the wavemeter fairly independent of the position of the telephone leads, at least so long as they are not closely drawn across some part of the wavemeter or wrapped around it. A more precise indicating device is a

thermogalvanometer or a radio-frequency milliammeter. Available types of thermo couple instruments are usually found more satisfactory than the ordinary expansion type of hot-wire instrument, because they respond more quickly to changes of current. The instrument should give full scale deflection with a current of about 0.1 ampere. It should be able to stand a considerable overload. It is generally inserted directly in the wavemeter circuit, sometimes with a shunt to keep low the resistance of the circuit. It is important to note that the presence of the instrument will probably modify the capacity, inductance and resistance of the circuit, so that the wavemeter should be calibrated with the same instrument in the circuit as will be used in measuring frequencies. An inexpensive indicating device and one which is satisfactory when the power output of the generating circuit is large enough, is a miniature lamp, such as a flashlight lamp, inserted directly in the wavemeter circuit. To avoid any possibility of changing the calibration of the wavemeter, the lamp should not be changed if it can be avoided. If it must be changed it should be replaced by one of identically the same kind. The sensitiveness of this device can be greatly increased by having a dry cell and a rheostat in parallel with the lamp in the wavemeter circuit. By adjusting the rheostat until the temperature of the lamp filament is raised almost to the point of illumination, it is possible to have the lamp lighted by induced currents much smaller than would otherwise be required. However, changes in the battery and rheostat will be likely to change the characteristics of the circuit and hence the calibration of the wavemeter. This device should therefore be used with caution.

The wavemeter may be excited by impact, that is by a source of highly damped waves having only a very few waves in a train. (See "The Principles Underlying Radio Communication," Signal Corps Radio Communication Pamphlet No. 40, p. 278, and Bureau of Standards Circular No. 74.) The wavemeter can then be used as a source of damped waves to determine the frequency to which a receiving set is tuned. The buzzer, in series with the battery, is connected across the condenser terminals, completing its circuit, when the contact is closed, through the inductance coil of the wavemeter. Not more than four volts should be used to operate the buzzer. The buzzer will add to the capacity of the circuit, thereby decreasing its frequency. This decrease will be especially noticeable at the lower part of the condenser scale, where it may amount to several per cent of the frequency. It can be reduced by having short, widely spaced leads to battery and buzzer. If the wavemeter is equipped with both a buzzer and an ammeter or current-square meter, the ammeter must be so connected in the circuit that the current from the buzzer battery can not pass through the ammeter. If this is not done, the ammeter or current-square meter may be burned out by the current caused to pass through it by the buzzer battery.

The assembling of the parts of the wavemeter must be such that each part is rigidly joined to the rest of the circuit. Mounting in a box is as good a means to this end as any from the standpoint of rigidity and is superior to any in portability and in the protection afforded to the parts. A convenient box mounting is shown in Fig. 1.

The overall dimensions are left to the constructor since the size of the component parts will vary. The box should be substantially constructed so that it will stand considerable handling The component parts are all mounted on a panel of rigid electrical insulating material which will not absorb moisture. This panel is, in turn, secured to the supporting box. It is possible to use a panel of thoroughly dried and seasoned hard wood thoroughly varnished with an extra grade of insulating varnish. Fig. 1 shows one possible distribution of the component parts. Attention should be given to the convenience of operation and advantageous wiring of the circuit to keep distributed capacities at a low value. The most advantageous arrangement of the instruments on the panel will depend in part on the particular instruments used, and the constructor should work out the best arrangement in each case.

Fig. 2 gives a circuit diagram showing the connections as they should appear underneath the panel. These connections should be made of No. 12 solid copper wire soldered into lugs. Where bending is necessary, sharp right angle bends are used. If it is desired to make a short-wave portable receiving set, terminals for antenna and ground connections can be supplied without decreasing the value as a wavemeter in any way, provided suitable care is used in handling the instrument. A wavemeter should be handled much more carefully than an ordinary receiving set. If it is desired to shield the wavemeter, a copper or brass sheet can be permanently fixed on the under side of the panel and spaces cut in it to allow for the terminals and supports of the various units. There should be at least one-eighth of an inch clearance for the terminals. Fig. 3 gives the dimensions and construction of the inductance coils.

The forms are turned in a lathe from thoroughly seasoned wood. Several coats of extra grade insulating varnish applied to this form will be desirable in keeping low the absorption of moisture. The proper number of turns of the correct size of wire is wound in a single layer in the recess provided for this purpose. A light coat of extra grade insulating varnish is applied to the wire to keep it in place and to prevent moisture from changing the distributed capacity of the coil. The terminals of the inductance coil are brought out through the wood form and soldered to the supporting brass terminals. The wood screws holding the coil form to the brass supports should be of brass rather than a magnetic material.

It is desirable that the box be provided with a protecting cover and a carrying handle.

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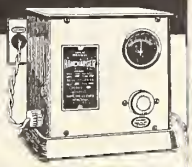

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After the wavemeter has been constructed, it must be calibrated. This service has been done in the past by the Bureau of Standards. It has lately been necessary, however, on account of the limited personnel available for this work, to limit the tests of radio materials made by this Bureau to tests of precision instruments which will in turn be used as standards for testing considerable numbers of other instruments, tests for Government institutions and state universities, and a few other tests for which there is a special reason why they should be undertaken by this Bureau. Standardization of instruments of the kind described in this Circular can be obtained from various commercial firms and some college and university laboratories.

Consideration has been given to the transmission of standard wave length signals from laboratories equipped with precision measuring apparatus. This would make it possible to determine accurately several points on the calibration curve of a wavemeter without sending it to a standardizing laboratory. The carrier waves of some radio telephone broadcasting stations may be adjusted to some particular wave, such as 360 meters, and one point on a wave length calibration can thus be determined. A wavemeter transported for standardization should be packed in a wooden box large enough to give room for three inches of excelsior on every side, otherwise the wavemeter may easily receive internal damage which will not appear except in its subsequent behavior. The package should be marked "Scientific Instrument. Handle with Care."

Two cautions are offered as to the use of the finished and standardized wavemeter. The first is, not to subject the instrument to any treatment apt to change its calibration. The second is not to couple it too closely to the source of the radio-frequency current which is being measured. The latter error can be avoided by never having the wavemeter so close to this source that it can not be brought closer without changing the setting for resonance.

It is possible to make a decremeter out of a wavemeter by placing a suitable scale on the variable condenser. For a wavemeter having a condenser with semicircular plates or any condenser such that the graph of its capacity against its setting is a straight line, the capacity being very small at zero setting, it can be shown that the decrement scale to be used is one in which the graduations vary as the logarithm of the angle of rotation.* Such a scale, designed for a semicircular plate condenser, is shown in Fig. 2. This scale may be copied or cut from this circular and trimmed to fit the dimensions of the condenser dial with which it is to be used. It may be made stationary with a moving pointer traveling over it, or it may be mounted on a dial rotating under a fixed pointer. At the setting corresponding to maximum capacity the scale reading should be zero. Since the scales of most condensers read counter-clockwise, this arrangement usually places the decrement scale in the unused space opposite the capacity scale. A measurement of decrement is made by first observing the current squared at resonance, then reading the decrement scale at the settings on either side of resonance where the current squared has one-half its value at resonance. The scale is so constructed that the difference between these two readings is equal to $\delta' + \delta$, that is, the decrement of the transmitting circuit plus the decrement of the wavemeter itself. It is then necessary to subtract the wavemeter decrement from the total just obtained. The decrement of the wavemeter is determined as follows: The wavemeter is coupled and tuned to a source of unmodulated continuous waves. The sum, $\delta' + \delta$ is measured as just described. Since the waves are continuous, δ, the decrement of the waves, is zero and the result obtained is δ', the decrement of the wavemeter alone. From determinations of the decrement of the wavemeter made at different points on the scale, the calibration curve of decrement plotted against condenser setting is obtained. The conditions necessary to permit the use of this scale in the manner described are as follows:

(1) The condenser must have semicircular plates. Condensers with plates of a different pattern will have different decrement scales just as they have different capacity calibrations.

(2) It must be remembered that only when resonance is indicated by a current-square meter is the deflection to be reduced to one-half its maximum value in detuning to either side of resonance. If a milliammeter is used, the reading must be reduced not to one-half its maximum value but to the maximum value divided by the square root of 2 or to 0.71 of the maximum value.

(3) The generator must have an output sufficiently large that the coupling employed may be loose enough to prevent any considerable reaction of the wavemeter on the generator.

(4) Neither the generator nor its coupling with the wavemeter must be changed during the measurement of decrement.

The following precaution is to be observed in measuring the decrement of a transmitting station: The decremeter must be coupled only to the antenna circuit to be measured, not to the primary circuit; consequently it should be kept not less than two meters away from the oscillation transformer, and coupling to the antenna circuit should be obtained by placing the decremeter near the antenna or ground lead, preferably the latter. If the antenna current is small, it will be necessary to make a single turn of small diameter in the lead to which the decremeter is coupled.

*J. H. Dellinger. Measurements of radio-frequency resistance, phase difference and decrement, Proc. I. R. E., vol. 7, pp. 27-61, Feb., 1919. Circular 74 of the Bureau of Standards, Radio Instruments and Measurements, p. 197.

Radio Night School

To meet an ever-growing demand for instruction in radio telegraphy and telephony the night school of the Junior College will offer a course covering these subjects. The work of the class is divided equally between lectures and code practice. Illustrated lectures cover such subjects as electrical units, storage batteries, generators, motors, transformers, inductance, electrical resonance, and other essential phases of the work. Because this course has been given in the day school of Junior College, an adequate equipment for the laboratory has been collected.

Head sets and keys are furnished for code practice. Further receiving practice is found in the use of up-to-date receiving sets. The transmitting sets available consist of both spark and continuous wave apparatus.

Other courses to be given include those in sociology, rhetoric, French, Spanish, psychology, history, economics, drama, general inorganic chemistry, and public speaking.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912.

of RADIO AGE published monthly at Mount Morris, Ill., for October 1, 1922.

State of Illinois, } ss.
County of Cook }

Before me, a Notary Public, in and for the state and county aforesaid, personally appeared Frederick Smith, who having been duly sworn according to law, deposes and says that he is the Editor of the Radio Age magazine, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Radio Age, Inc., 64 W. Randolph St., Chicago; Editor, Frederick Smith, 64 W. Randolph St., Chicago; Managing Editor, Frederick Smith, 64 W. Randolph St., Chicago; Business Manager, M. B. Smith, 64 W. Randolph St., Chicago.

2. That the owners are: (Give names and addresses of individual owners, or, if a corporation, give its name and the names and addresses of stockholders owning or holding 1 per cent or more of the total amount of stock.)

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3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) NONE.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

Frederick Smith,
Editor.

Sworn to and subscribed before me this 28th day of September, 1922.
[SEAL]
HARRIET DILLON.
(My commission expires June 5, 1923.)

NEW BROADCASTING STATIONS

ABBREVIATIONS

The necessary corrections to the List of Radio Stations of the United States and to the International List of Radiotelegraph Stations, appearing in this Bulletin under the heading "Alterations and corrections," are published after the stations affected in the following order:

Name = Name of station.
Loc. = Geographical location: O = west longitude, N = north latitude, S = south latitude.
Call = Call letters assigned.
System = Radio system used and sparks per second.
Range = Normal range in nautical miles.
W. l. = Wave lengths assigned; Normal wave lengths in italics.
Service = Nature of service maintained:
PG. = General public.
PR = Limited public.
RC = Radio compass station.
P = Private.
O = Government business exclusively.
Hours = Hours of operation.
N = Continuous service.
X = No regular hours.
m = a. m. (12m = midday).
s = p. m. (12s = midnight).
Rates = Ship or coast charges in cents: c = cents. (The rates in the international list are given in francs and centimes.)
I. W. T. Co. = Independent Wireless Telegraph Co.
R. C. A. = Radio Corporation of America.
S. O. R. S. = Ship Owners' Radio Service.
C. w. = Continuous wave.
I. c. w. = Interrupted continuous wave.
V. t. = Vacuum tube.
FX. = Fixed station.

Alphabetically by names of cities.

[Additions to the List of Radio Stations of the United States, Radio Service Bulletin, edition June 30, 1922.]

Commercial land stations, alphabetically by names of stations.

[Additions to the List of Radio Stations of the United States, edition of June 30, 1922, and to the International List of Radiotelegraph Stations published by the Berne bureau.]

Station.	Call signal.	Wave lengths.	Service.	Hours.	Station controlled by—
Ceiba, P. R.[1]	WKK	300,*600*, 1610	PG & PR		Bureau of Insular Telegraph.
Chicago, Ill.[2]	WBU	420	P	X	City of Chicago.
Cleveland, Ohio[3]	WGO	300, 450, *600*	PG		RCA.
Cranston, R. I.	WKAP	300, 475, *600*	P	X	Dutee W. Flint.
Los Angeles, Calif.[4]	KFR	300, 525, *600*	P	X	Airline Transportation Co.
Pearl Creek Dome, Cold Bay oil district, Alaska[5].	KFU	1700	P	X	Standard Oil Co. of Calif.
Princeton, Ind.[6]	WJAV	1625	P	X	Indian Pipe Line Corp.
Raleigh, N. C.[7]	WLAC	500	P	X	North Carolina State College.
San Francisco, Calif.[8]	KUO	300, 525, *600*	P	X	Examiner Printing Co.
Vieques, P. R.[9]	WGW	300, *600*, 1610	PG & PR		Bureau of Insular Telegraph.

[1] Loc. (approximately) 0.65° 39′ 00″, N. 18° 16′ 00″; range, 150 system, De Forest v. t. telephone and telegraph; hours, 8 a m.–12 noon, 1–6 and 7–8 p. m.; rates, ship service, 6 c. per word, Ceiba to Vieques 5 c. per word, minimum 40c, for 10 words.

[2] Loc. 0.87° 37′ 20″, N. 41° 52′ 26″; range, 200; system, De Forest v. t. telegraph and telephone; rates, none.

[3] Range, 100; system, RCA (c. w., i. c. w., and v. t. telephone); hours, 23 hours during every 24; rates, ship service, 3 c. per word.

[4] Range, 100; system, composite v. t. telephone; rates, none.

[5] Loc. (approximately) 156° 04′ 00″, N. 57° 42′ 00″; range, 300; system, RCA, 1,000; rates, none.

[6] Loc. (approximately) 0.87° 29′ 00″, N. 38° 17′ 00″; range, 200; system, De Forest v. t. telegraph and telephone; rates, none.

[7] Loc. 0.78° 39′ 45″, N. 35° 47′ 35″, range, 300; system, composite v. t. telegraph and telephone; rates, none.

[8] Range, 150; system, composite v. t. telephone; rates, none.

[9] Loc. (approximately) 65° 26′ 33″, N. 18° 09′ 00″; range, 150; system, De Forest v. t. telegraph and telephone; hours, 8 a. m.–12 noon, 1–6 and 7–8 p. m.; rates, ship service, 6 c. per word; Vieques to Ceiba, 5 c. per word, minimum, 40c. for 10 words.

Commercial land and ship stations, alphabetically by call signals.

[b = ship station; c = land station.]

Call signal	Name.		Call signal.	Name.
KFAX	Chillicothe	b	WBU	Chicago, Ill.
KFBO	Ara	b	WGO	Cleveland, Ohio.
KFBP	Moldegaard	b	WGW	Vieques, P. R.
KFBT	Commercial Scout	b	WJAV	Princeton, Ind.
KFR	Los Angeles, Calif.	c	WKAP	Cranston, R. I.
KFU	Pearl Creek Dome, Cold Bay oil district, Alaska	c	WKK	Ceiba, P. R.
KUO	San Francisco, Calif.	c	WLAC	Raleigh, N. C.

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Broadcasters Form National League

(Continued from page 4)

enport Iowa. (WOC).

William J. Clark, Radio Editor, Chicago Evening American.

J. C. Hail, City Hall Station, Chicago (WBU).

T. B. Hatfield, Indianapolis, Ind. (WOH).

T. W. Findley, Minneapolis, Minn. (WLAG).

Arthur H. Ford, State University of Iowa (WHAA).

Milo E. Westbrooke, National Radio Exposition, Chicago.

George Lewis, National Radio Chamber of Commerce.

Harold Power, Medford Hillside, Mass. (WGI).

Ralph C. Watrous, National Radio Chamber of Commerce.

Kenneth P. Gregg, National Radio Chamber of Commerce.

John P. Tansey, Radio Club of Illinois.

W. C. Evans, Westinghouse Electric and Mfg. Co., Chicago (KVW).

E. A. Beane, U. S. Radio Inspector, Ninth District.

W. J. Wecherbee, Westinghouse Electric and Mfg. Co., Chicago (KYW).

C. B. Cooper, Ship Owners' Radio Society, Inc., N. Y. City (WCAP).

Four Minutes From Cavite

The transmission of a routine radio message from the Naval Station at Cavite, Philippine Islands to Washington, D. C., was accomplished recently by the Naval Communications Service within four minutes. The total distance was 11,500 miles.

Ordinarily, with the delay on account of schedules, a message from Cavite to the Navy Department would not be delivered in less than several hours, and sometimes a whole day is required in the transmission, due to relaying, static, etc.

Of course the message was relayed at San Francisco where it was received from Cavite, but as the radio circuit to Washington was "set up" the message was relayed immediately. Within four minutes after the sixteen-words dispatch left Cavite, it was received on the aerials on top of the Navy Building in Washington and read in the receiving room below. Radio communication is said to be instantaneous, and a signal is instantaneous, but a message is slower due to the fact that time is required to transmit record, retransmit and rerecord.

Westward, trans-Pacific Radio messages are relayed to Guam and Cavite through Honolulu. Recently through the operation of the Fanning electrical relay at Honolulu 184 words were automatically relayed to Guam from San Francisco, without being transcribed or retransmitted.

Broadcasting stations, alphabetically by names of cities.

[Additions to the List of Radio Stations of the United States, edition June 30, 1922.]

City.	Call signal.	City.	Call signal.
Astoria, Oreg.	KFBM	Louisville, Ky.	WKAG
Beaumont, Tex.	WMAM	Marshall, Mo.	WJAT
Beloit, Wis.	WKAW	Marshfield, Oreg.	KFBH
Boise, Idaho	KFBJ	Miami, Fla.	WIAZ
Bridgeport, Conn.	WKAX	Montgomery, Ala.	WKAN
California (portable)	KFBN	Okemah, Okla.	WKAK
Carrollton, Mo.	WLAB	Omaha, Nebr.	WNAL
Central Point, Oreg.	KFAY	Orange, Tex.	WKAL
Chicago, Ill.	WJAZ	Peoria, Ill.	WJAN
Cleveland, Ohio	WJAX	Pittsburgh, Pa.	WJAS
Cranston, R. I.	WKAP	Providence, R. I.	WJAR
Duluth, Minn.	WJAP	Raleigh, N. C.	WLAC
East Lansing, Mich.	WKAR	Rock Port, Mo.	WMAD
East Providence, R. I.	WKAD	Sacramento, Calif.	KFBK
Everett, Wash.	KFBL	San Francisco, Calif.	KFDB
Fargo, N. Dak.	WKAJ	San Juan, P. R.	WKAQ
Frankfort, Ind.	WKAT	Springfield, Mo.	WKAS
Gainesville, Ga.	WKAY	Syracuse, N. Y.	WLAH
Hastings, Nebr.	WKAM	Topeka, Kans.	WJAQ
Hastings, Nebr.	WLAD	Waco, Tex.	WLAJ
Laconia, N. H.	WKAV	West Palm Beach, Fla.	WKAH
Lincoln, Nebr.	WLAF	Wilkes-Barre, Pa.	WKAZ
Lincoln, Nebr.	WMAH	Yankton, S. Dak.	WJAU

Lists of stations broadcasting market or weather reports (485 meters) and music, concerts, lectures, etc. (360 meters), alphabetically by call letters.

[Additions to the List of Radio Stations of the United States, edition June 30, 1922.]

Call signal.	Station operated and controlled by—	Location of station.	Wave lengths.
KFAY	W. J. Virgin Milling Co.	Central Point, Oreg.	360
KFBH	Thomas Musical Co.	Marshfield, Oreg.	360
KFBJ	Idaho Radio Supply Co.	Boise, Idaho	360
KFBK	Kimball-Upson Co.	Sacramento, Calif.	360
KFBL	Leese Bros.	Everett, Wash.	360
KFBM	Cook & Foster	Astoria, Oreg.	360
KFBN	Borch Radio Corp.	California (portable)	360
KFDB	John D. McKee	San Francisco, Calif., 464 California Street	360
WIAZ	Electric Supply Sales Co.	Miami, Fla.	360
WJAN	Peoria Star-Peoria Radio Sales Co.	Peoria, Ill.	360
WJAP	Kelley-Duluth Co.	Duluth, Minn.	360
WJAQ	Capper Publications	Topeka, Kans.	360
WJAR	The Outlet Co. (J. Samuels & Bro.)	Providence, R. I.	360
WJAS	Pittsburgh Radio Supply House	Pittsburgh, Pa.	360
WJAT	Kelly-Vawter Jewelry Co.	Marshall, Mo.	360
WJAU	Yankton College	Yankton, S. Dak.	360
WJAX	Union Trust Co.	Cleveland, Ohio	360
WJAZ	Chicago Radio Laboratory	Chicago, Ill.	360
WKAD	Charles Looff (Crescent Park)	East Providence, R. I.	360
WKAG	Edwin T. Bruce, M. D.	Louisville, Ky., 1300 South Third Street	360
WKAH	Planet Radio Co.	West Palm Beach, Fla.	360
WKAJ	Fargo Plumbing & Heating Co.	Fargo, N. Dak.	360
WKAK	Okfuskee County News	Okemah, Okla.	360
WKAL	Gray & Gray	Orange, Tex.	360
WKAM	Hastings Daily Tribune	Hastings, Nebr.	360
WKAN	Alabama Radio Mfg. Co.	Montgomery, Ala.	360
WKAP	Dutee W. Flint	Cranston, R. I., Allens Avenue	360
WKAQ	Radio Corp. of Porto Rico	San Juan, P. R.	360
WKAR	Michigan Agriculture College	East Lansing, Mich.	360
WKAS	L. E. Lines Music Co.	Springfield, Mo.	360
WKAT	Frankfort Morning Times	Frankfort, Ind.	360,485
WKAV	Laconia Radio Club	Laconia, N. H.	360
WKAW	Turner Cycle Co.	Beliot, Wis.	360
WKAX	William A. MacFarlane	Bridgeport, Conn.	360
WKAY	Brenau College	Gainesville, Ga.	360
WKAZ	Landau's Music & Jewelry Co.	Wilkes-Barre, Pa.	360
WLAB	George F. Grossman	Carrollton, Mo.	360
WLAC	North Carolina State College	Raleigh, N. C.	360
WLAD	Arvanette Radio Supply Co.	Hastings, Nebr.	360
WLAF	Johnson Radio Co.	Lincoln, Nebr.	360
WLAH	Samuel Woodworth	Syracuse, N. Y., 425 Brownel Street	360
WLAJ	Waco Electrical Supply Co.	Waco, Tex.	360
WMAD	Atchinson County Mail	Rock Port, Mo.	360
WMAH	General Supply Co.	Lincoln, Nebr.	360
WMAM	Beaumont Radio Equipment Co.	Beaumont, Tex.	360
WNAL	R. J. Rockwell	Omaha, Nebr., 5019 Capitol Avenue	360

Special land stations, alphabetically by names of stations.

[Additions to the List of Radio Stations of the United States, edition of June 30, 1922.]

Station.	Call signal.	Wave lengths.	Station controlled by—
Altadena, Calif.	6XR	150,275,375	Altadena Radio Laboratory.
Beeville, Tex.	5ZAI	*200*,375	Rialto Theater.
Chicago, Ill.	9XN	variable	Leroy M. E. Clausing, 4545 North Whipple Street.
Columbus, Ohio	8XC	*200*,375	Erner & Hopkins Co.
Kalamazoo, Mich.	8XF	*200*,375	Kalamazoo College (physics department)
Los Angeles, Calif.	6XJ	200-550	Dean Farran, 1410 South Van Ness Avenue.
New York, N. Y.	2XU	420	American Radio News Corp., 21 Spruce St.
Oakland, Calif.	6XA	variable	Radio Specialty Shop.
Philadelphia, Pa.	3XAI	250,275	Roberts Bros. Elec. Co., 426 South Fifty-second Street.
Plainview, Tex.	5XAH	*200*,375	James G. McInnish
Rockford, Ill.	9XF	variable	A. V. Tronske.
San Francisco, Calif.	6XB	variable	John D. McKee, 464 California Street.

Special land stations, grouped by districts.

Call signal.	District and station.	Call signal.	District and station.
2XU	Second district: New York, N. Y.		Eighth district:
3XAI	Third district: Philadelphia, Pa.	8XC	Columbus, Ohio.
	Fifth district:	8XF	Kalamazoo, Mich.
5XAH	Plainview, Tex.		Ninth district:
5ZAI	Beeville, Tex.	9XF	Rockford, Ill.
	Sixth district:	9XN	Chicago, Ill.
6XA	Oakland, Calif.		
6XB	San Francisco, Calif.		
6XJ	Los Angeles, Calif.		
6XR	Altadena, Calif.		

Alterations and Corrections

Broadcasting stations, by call signals.

KDYS (Great Falls, Mont.).—W. l., 360, 485.
KDZH (Fresno, Calif.).—W. l., 360, 485.
KLN (Del Monte, Calif.).—Station operated and controlled by Monterey Electric Shop.
KNR (Los Angeles, Calif.).—Strike out all particulars.
KSD (St. Louis, Mo.).—W. l., 360, 485.
KSV (Wenatchee, Wash.).—W. l., 360, 485.
KVQ (Sacramento, Calif.).—Station operated and controlled by James McClatchy
KYI (Bakersfield, Calif.).—Station operated and controlled by Bakersfield Californian (Alfred Harrel).
KZI (Los Angeles, Calif.).—Strike out all particulars.
WCAP (Decatur, Ill.).—W. l., 360, 485.
WCAU (Philadelphia, Pa.).—W. l., 360, 485.
WDAF (Kansas City, Mo.).—W. l., 360, 485.
WDAH (El Paso, Tex.).—W. l., 360, 485.
WDAJ (College Park, Ga.).—W. l., 360, 485.
WEAC (Terre Haute, Ind.).—W. l., 360, 485.
WEAP (Mobile, Ala.).—W. l., 360, 485.
WHU (Toledo, Ohio).—W. l., 360, 485.
WJAM (Cedar Rapids, Iowa).—Address 302 3rd Ave. West.
WOO (Philadelphia, Pa.).—W. l., 360, 485.
WSY (Birmingham, Ala.).—W. l., 360, 485.

New Stations in 9th District

Licenses issued during month ending September 30, 1922

Call signal	Station operated and controlled by—	Location of station.
9CVA	Boyd L. Thorp	Second and Edith Sts., Murphysboro, Ill.
9CVB	Philip A. Wachtell	123 W. Adams St., Munice, Ind.
9CVC	Herbert Wall	1440 Cook St., Denver, Colo.
9CVD	Joseph J. Bremken	217 N. 26th St., Omaha, Nebr.
9CVE	Dale M. Ashby	415 N. Church St., Gibson City, Ill.
9CVF	Leonard M. Schwabe	508 N. William St., Columbia, Mo.
9CVG	Fred C. Heinze	Wilson, Kansas
9CVH	Willis E. Ranney	1646 Beachwood Ave., Louisville Ky.
9CVI	Edward T. Howell	641 Van Buren St., Milwaukee, Wisc.
9CVJ	Paul M. A. Milker	912 N. 8th St., Fargo, N. Dak.
9CVK	Edwin J. DeCosta	Box 153, Lake Villa, Ill.
9CVL	Carl P. Budke	Gore and Glendale Rd., Webster Groves, Mo.
9CVM	William R. Coyne	131 Sheridan Ave., North, Minneapolis, Minn.
9CVN	John F. Palmquist	2908 S. 42d Ave., Minneapolis, Minn.
9CVO	Harold W. Siebens	5772 DeGiverville St., St. Louis, Mo.
9CVP	James P. Burke	3011 Union Ave., St. Louis, Mo.
9CVQ	Noel Bader	4433 Clarence Ave., St. Louis, Mo.
9CVR	Albert B. Marshall	950 S. 5th St., Louisville, Ky.
9CVS	Frederick Mumm	7219 Jackson Blvd., Forest Park, Ill.
9CVT	Bernhard W. Alden	723 N. 9th St., Kansas City, Kans.
9CVU	Norbert W. Knoernschild	644—28th St., Milwaukee, Wisc.
9CVV	Richard D. Leffholm	2616—4th Ave., S., Minneapolis, Minn.
9CVW	Edward Goodberlet	3712 Finney Ave., St. Louis, Mo.
9CVX	Richard H. Fitch	1408 Capitol St., Yankton, S. Dak.
9CVY	Edward D. Lindsay	1017 Admiral Blvd., Kansas City, Mo.
9CVZ	L. M. Turner	412 State St., Beloit, Wisc.
9CWA	Orene G. Cathcart	1404 E. Third St., Winfield, Kans.
9CWB	George Furtney	1302 Wilson Ave., Columbia, Mo.
9CWC	Lincoln J. Simms	850 Faulkner Ave., Wichita, Kans.
9CWD	John R. Greene	Gore and Glendale Rd., Webster Groves, Mo.
9CWE	Leo Conner	Broadway, Greenwood, Ind.
9CWF	John N. Burnside	112 Boone St., Boone, Iowa.
9CWG	Thomas J. Clinton	1206 S. 15th St., Springfield, Ill.
9CWH	Norman J. Atwell	Dexter, Minn.
9CWI	Everett Stone	90 Pewabic St., Houghton, Mich.
9CWJ	Fred. A. Lankton	148 W. Dakota St., Denver, Colo.
9CWK	Vance E. Olson	847 E. 57th St., Chicago, Ill.
9CWL	Edwin S. Van Buskirk	829—14th St., Denver, Colo.
9CWM	Herbert T. Hintgen	224 Dakota Ave., Wahpeton, N. Dak.
9CWN	Harry Samuels	411 N. 7th St., St. Louis, Mo.
9CWO	C. W. Otis	17 E. Washington St., Greencastle, Ind.
9CWP	Thomas E. Lenigan	1247—6th St., Beloit, Wisc.
9CWQ	David C. Maloney	1824 Pine St., Murphysboro, Ill.
9CWR	Edwin L. Benton	222 Main St., LaCrosse, Wisc.
9CWS	Robert F. Edgar	3821 S. 4th Ave., Minneapolis, Minn.
9CWT	John H. Smith	936 E. Maple St., Jeffersonville, Ind.
9CWU	Henry S. Duttweiler	R. F. D. No. 1, Lockridge, Iowa.
9CWV	Verner Hicks	901 S. Mechanic St., Marion, Ill.
9CWW	Robert H. Freeman	Chicago Ranch, Briggsdale, Colo.
9CWX	Clarence A. Brockert	911 W. Main St., Plattsville, Wisc.
9CWY	Frank Bubacek	R. F. D. No. 1, Cedar Rapids, Iowa
9CWZ	Paul Wichman	Belmont, Wisc.
9CXA	Ben Herr	R. F. D. No. 3, Lebanon, Ind.
9CXB	Garvin H. Dyer	1321 Concord St., Springfield, Mo.
9CXC	Albert W. Brown	370—45th St., Milwaukee, Wisc.
9CXD	Robert Van Derwarn	1305 Park Ave., Racine, Wisc.
9CXF	Carroll J. Burnside	322 Quincy St., Rapid City, S. Dak.
9CXF	Clemens E. Spellman	810 Ella St., Beatrice, Nebr.
9CXG	Robert F. Bartl	1515 State St., LaCrosse, Wisc.
9CXH	Leo. L. Drolet	265 Main St., Bourbonaise, Ill.
9CXI	A. G. Schwerling	733 Linden Ave., Newport, Ky.
9CXJ	William L. Cobb	2908 Arsenal St., St. Louis, Mo.
9CXK	William Barrett	3200 Gilham Road, Kansas City, Mo.
9CXL	Theresa E. Finnell	621 E. Water St., Pontiac, Ill.
9CXM	Chester Roney	110 N. Ball St., Webb City, Mo.
9CXN	George E. Marshall	2045 S. Lawrence St., Wichita, Kans.

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Send $1.00 to Radio Age, 64 Randolph Street, Chicago, and receive this middle-west radio periodical for six months. Regular subscription price is $2.50 a year. Thus you will be getting two months free.

Set Clocks by Radio!

By Carl H. Butman

Washington, D. C., Oct. 23.—Through naval radio broadcasts, it is now possible to set your clocks and watches to standard time twice daily, provided you have a radio receiving set. At noon and at 10 every night the naval radio stations at Arlington, Annapolis and Key West transmit signals, indicating the exact time for the 75th Meridian, or standard Eastern time.

The actual time is kept at and sent from the Naval Observatory in Washington, the source of standard time for the territory east of the Rocky Mountains, the Chronometer and Time Office at the Naval station at Mare Island, California, serving the Western territory and ships off the Pacific Coast.

The Clocks Are Wrong, But—

In a deep, even-temperature vault at the Naval Observatory three Riefler clocks keep sidereal, or star time, and although they are not quite correct, it doesn't matter. They are checked by the observation of certain stars as they cross the meridian, and their exact error and rates of error calculated. Having obtained the exact Washington sidereal time, a correction for the difference in longitude of Washington and the 75th meridian, which is eight minutes and about fifteen seconds, is made to secure Eastern standard time. This is kept on two transmitting clocks, one of which sends out the time signal to the three radio transmitting stations by means of a relay.

Previously to sending the time signals, the sending clock is checked with one of the standard Riefler clocks, by comparing their ticks, which are recorded on a chronograph, wavy pen lines indicating the separate ticks. These are measured by a finely divided scale and compared. Determining the error, the sending clock is speeded up or slowed electrically until its ticks correspond exactly with the standard clock.

How to Get the Right Time by Radio

The ticks of the transmitting clock are sent to the three transmitting stations by closing a switch at the observatory, but they are broadcasted by radio from the three stations.

Five minutes is required to send a complete time signal, starting at 11:55 and running to noon, and from 9:55 to 10 p. m. The time signals consist of telegraphic dashes every second except the 29th of each minute; the 55th to 59th seconds of the first four minutes, and the 50th to 59th seconds inclusive of the last minute before the hour. Each of these blanks is caused by a missing tooth on an otherwise incomplete gear-wheel. Following the 59th second of the last minute, there is a long dash commencing at the beginning of the new hour. Listen in for N. A. A. on 2650 meters and set your clocks then.

By means of a radio receiving set at the Observatory the message of ticks may be caught and recorded on a chronograph for comparison with the sending clock's record to determine the loss in transmission. It averages about .09 of a second. The time signals sent from Annapolis on a wave length of 16,900 meters have been heard in Australia, while in the Antipodes time signals have been heard coming around the world both ways. With a receiving set it is now no excuse to say "my clock was wrong."

9CXO	Taylor H. Paisley	3706 Washington St., Kansas City, Mo.
9CXP	Eugene S. Strout, Jr.	303 W. 4th St., Waterloo, Iowa
9CXQ	Harry R. Heuer	5666 Cabanne Ave., St. Louis, Mo.
9CXR	Elmer C. Madson	Wayne Block, Yankton, S. Dak.
9CXS	Cloice Wagner	Main St., West McHenry, Ill.
9CXT	Richard M. Purinton	154—9th St., Lincoln, Ill.
9CXU	Roy E. Gorzney	512 Morris St., W., Morrison, Ill.
9CXV	William W. Eymer	811 Douglas Ave., Yankton, S. Dak.
9CXW	David E. Sparks	3638 Rokeby St., Chicago, Ill.
9CXX	William L. Perdue	104 Brown St., Hopkinsville, Ky.
9CXY	Fred L. Reed	2906 1-2 Arsenal St., St. Louis, Mo.
9CXZ	Hilton Hushower	722 Pennsylvania Ave., South Bend, Ind.
9CYA	Clark Radio Shop	128—38 S. Second St., DeKalb, Ill.
9CYB	Raymond L. Herchert	1619 Union Ave., St. Louis, Mo.
	CALLS REISSUED	
9AS	Fred L. Demarin	3219 W. Fifth Ave., Chicago, Ill.
9GT	Randall Wright	2114 Morse Ave., Chicago, Ill.
9QB	Sam Burdett	6464 Dorchester Ave., Chicago, Ill.
9UH	Vernon R. Lucas	820 N. 4th St., Fargo, N. Dak.
9API	Raymond Gomersall	2626—4th Ave., S., Minneapolis, Minn.
9AYY	McKinley High School	Missouri and Russell Sts., St. Louis, Mo.
9BSH	Albert B. Jordan	1014 Good Hope St., Cape Girardeau, Mo.
9CCB	General Radio Laboratories, Inc.	1730 Tribune Bldg., Chicago, Ill.
9DIS	John B. Bayard, Jr.	505 N. 6th St., Vincennes, Ind.
9DJL	Leslie M. DeVoe	Zionsville, Ind.
	CALLS CANCELLED	
9DJL	Harold R. DeTuncq	1696 Ashland Ave., St. Paul, Minn.
9XS	Manhattan Electrical Supply Co., Inc.	1106 Pine St., St. Louis, Mo
9YR	Munice Senior High School	Munice, Ind.
9ZH	Reorganized Church of Jesus Christ of the Latter Day Saints	202 Bowen St., Independence, Mo.
9AYY	Leon L. Drolet	265 Main St., Bourbonnais, Ill.
9BSH	Clarence Stallman	312 B. East St., Hutchinson, Kans.
9DIS	Robert Bartl	1515 State St., LaCrosse, Wisc.
9ZD	Edward C. Stockmann	140 W. Third Ave., Denver, Colo.
9UH	Bert S. Brown	26 Alexandria Pike, Clifton, Ky.
9ZZ	Walter M. Aronson and Albert R. Perkins	3952 Bellview St., Kansas City, Mo.
WAAP	Otto W. Taylor, c-o United Electric Co.	441 N. Roosevelt St., Wichita, Kans.
WFAK	Domestic Electric Company	7908 Eulalie St., Brentwood, Mo.
WBAE	Bradley Polytechnic Institute	Institute Place, Peoria, Ill.
WQX	Walter A. Kuehl	Riverview Park, Western and Belmont, Chicago, Ill.
WAAE	St. Louis Chamber of Commerce	511 Locust St., St. Louis, Mo.
9VAI	Transylvania University	Third and Broadway, Lexington, Ky.
WCAZ	Robert E. Compton and Quincy Whig-Journal	Quincy, Ill.
WKH	The Midland Refining Company	Norfolk Ave., and 4th St., Norfolk, Nebr.
	CHANGES IN ADDRESS.	
9BCV	Joyce E. Prather	100 Oak St., Mounds, Ill.
9PP	Harry F. Wilson	1105 Franklin Ave., Normal, Ill.
9APK	Harry B. Smith	114 Ridge Ave., Evanston, Ill.
9AKR	Albert C. Mertz	Byron, Ill.
9ATT	Stanley E. Fey	402 Armory St., Champaign, Ill.
9KM	Lawton Biddle	442 Bosart Ave., Indianapolis, Ind.
9DH	James Schulz	9th and Cedar Sts., St. Paul, Minn.
9AZR	Harold C. Armagost	327 W. 4th St., Florence, Kans.
9DXO	Vivian F. Munson	328 Williard St., Kewanee, Ill.
9AMI	J. Emerson Decker	119 Second St., S. E., Mason City, Iowa
9DSH	Earl Sullaway	212 N. Clinton St., Collinsville, Ill.
9LN	Waldo C. Grover	3214 S. Colfax St., Minneapolis, Minn.
9AJY	Walter J. Hammond	616 E. 23rd St., Pittsburg, Kans.
9AJH	John G. Beckley and N. H. Reeve	304 Chestnut St., Western Springs, Ill.
9ANF	Harry C. Harvey	135 N. 13th St., Lincoln, Nebr.
9DPL	Charles J. Bowers	1131 Virginia Ave., Kansas City, Kans.
9DGN	Russell Pelle	2704 Jefferson St., Louisville, Ky.
9BGD	Irving H. Cohen	241 E. 60th St., Chicago, Ill.
WDAP	Midwest Radio Central, Inc.	Drake Hotel, Chicago, Ill.
9CSK	Harry G. Crofts	Carrier Mills, Ill.
9BAX	Burton F. Miller	Box No. 165, Coloma, Wisc.
9BBF	Ernest T. Sperling	21 S. Jefferson St., New Ulm. Minn.
9BAZ	John B. Wathan	R. R. No. 1, Box 97, Mocking Bird Valley, Louisville, Ky.
9BBL	Ralph Schwartz	616 Montgomery St., Shelbyville, Ind.
9BBR	Joseph A. Brence	920 Adams St., Waukegan, Ill.
9AIL	Rudolph W. Martin	Rochester St., Mukwanago, Wisc.
9DSL	James H. Best	Cincinnati, Iowa
9EP	John W. Coleman	211 N. Broadway, Lexington, Ky.
9ALX	Stanley Tollman	3927 Beachwood Ave., Pine Lawn, Mo.
9DPB	Floyd K. Johnston	3319 Larimore Ave., Omaha, Nebr.
9QG	Robert E. Hughes	519 Asbury Ave., Evanston, Ill.
	BROADCASTING.	
WAAP	United Electric Co.	441 Roosevelt St., Wichita, Kans.
WLAG	Cutting & Washington Radio Corp.	230 Oak Grove, Minneapolis, Minn.
WLAP	W. V. Jordan	306 W. Breckenridge, Louisville, Ky.
WLAR	Mickel Music Co.	128 Main St., Marshalltown, Iowa
WLAS	Hutchinson Grain Radio Co.	Hutchinson, Kans.
WLAT	Bosch Company, Charles G.	317 Main St., Burlington, Iowa.
WLAX	Greencastle Community Broadcasting Station	17 Washington St., E. Greencastle, Ind.
WMAG	Tucker Electric Co.	217 N. Washington St., Liberal, Kans.
WMAJ	Drovers Telegram Co.	1505 Genesee St., Kansas City, Mo.
WNAB	Park City Daily News	413 Tenth St., Bowling Green, Ky.
WOAE	Midland College	Irving St., Fremont, Nebr.
	EXPERIMENTAL	
9XO	Morkrum Company	1410 Wrightwood Ave., Chicago, Ill.
9XP	Carrington, G. L.	300 S. Main St., El Dorado, Kans.
	SPECIAL	
9ZI	Anderson, Roy E.	235 Main St., Lexington, Ky.
	TECHNICAL AND TRAINED SCHOOL	
9YG	North Dakota Agricultural College	Fargo, N. Dak.
9YAQ	Southeast Mo. State Teachers' College	Normal Ave., Cape Girardeau, Mo.

(MISS) M. GUNNISON, Chief Clerk,
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Interest the Boy and he will sell Dad

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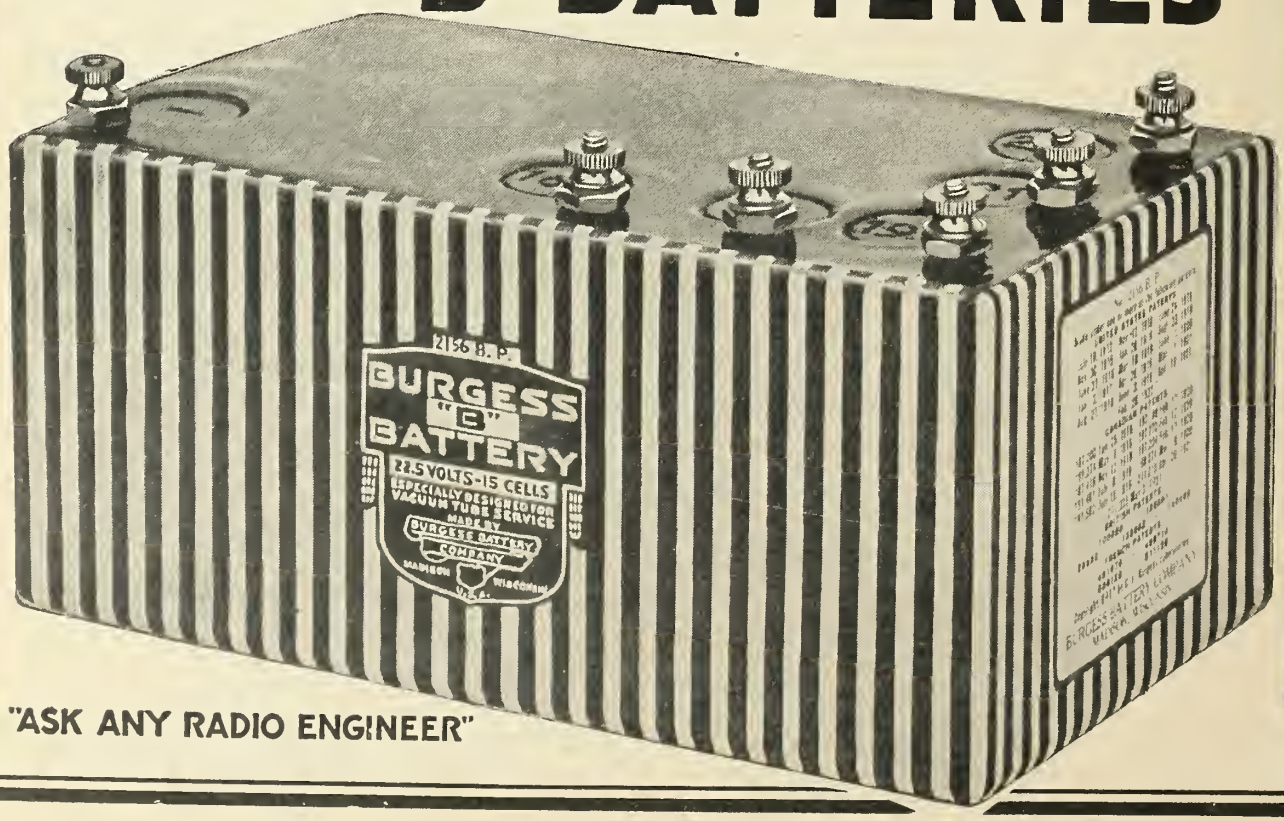

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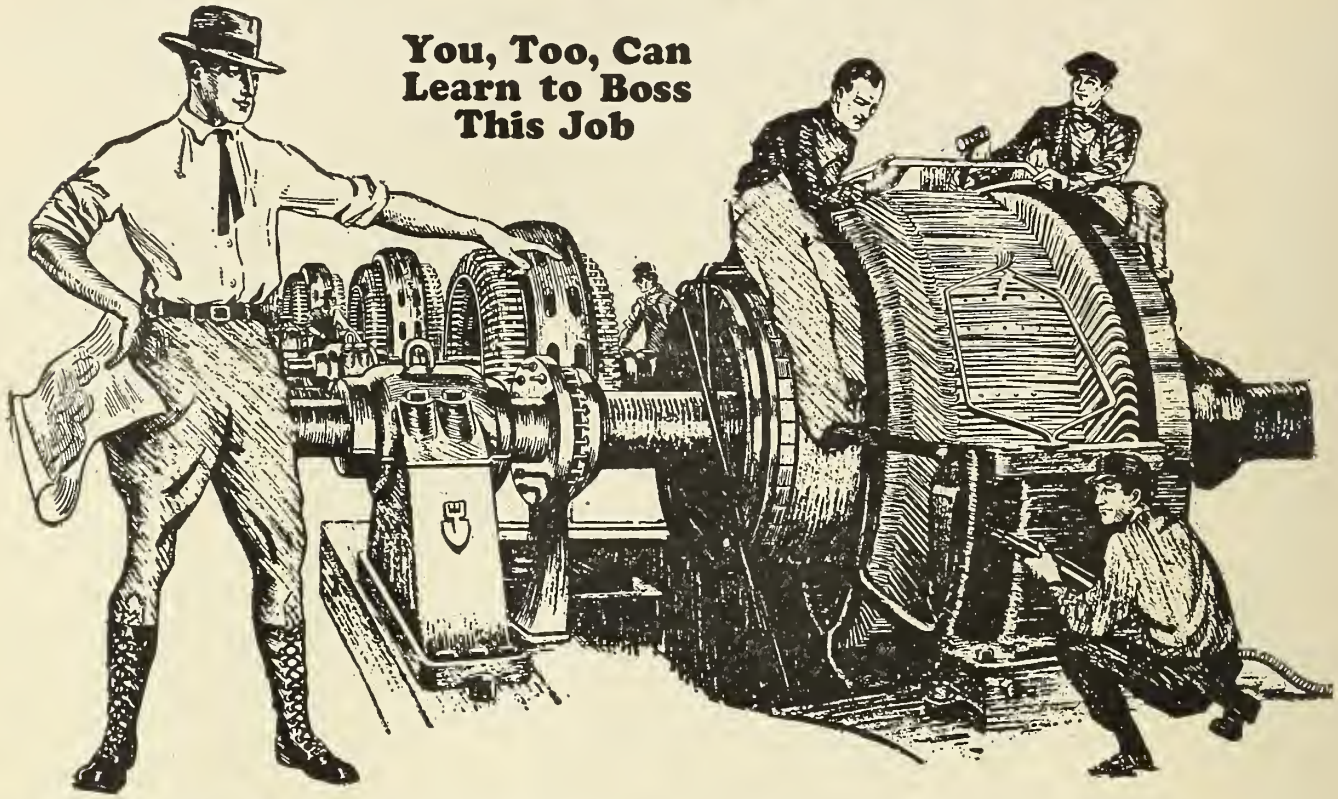

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1. Practical Money-Making Instruction—no useless, high-sounding theory.
2. Free Electrical Outfit. —Finest outfit ever sent out for home experiment and practical use.
3. Free Employment Service. (Helps you get a good job.)
4. Free Consulting Service. (No chance to get stuck on anything, while studying or afterward.)
5. Free Engineering Magazine.
6. Free use of my Electrical Laboratory.
7. Extra Courses Free—Radio—Electrical Drafting.
8. Spare Time Work—Special earn-while-you-learn lessons.
9. Reduced prices on all Electrical Supplies.
10. Cash Refund Guarantee Bond.

These features are all explained in my big Free Book.

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RADIO AGE

The Magazine of the Hour

Volume 1 *Number 7*

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Famous as Teacher

"SEND me Radio Age for one year," writes a Davenport, Ia., fan. "If Frank D. Pearne is technical editor of your magazine that's all I need to know."

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MOST IMPORTANT OF ALL Mr. Pearne conducts for this magazine the department of questions and answers and in that capacity he answers queries sent in by subscribers free of charge. A self-addressed and stamped envelope brings a prompt reply by mail.

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National Radio Week to Emphasize Educational Value of Radio Broadcasting

THE tremendous contribution of radio broadcasting to the educational life of the country is to be especially emphasized during NATIONAL RADIO WEEK, to be held from December 23 to 30.

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Sending of operatic arias out on the air has become frequent within the past few months. All the progress thus far made in that field, together with a wealth of new material and ideas, is to be assembled during NATIONAL RADIO WEEK for a grand display.

Announcement to this effect has just been made by J. Andrew White, chairman of the Executive Committee of NATIONAL RADIO WEEK. Mr. White and the Committee feel that the broadcasting of the highest type of music not only has recreational value but is inspirational in home circles, as well, and there is tremendous economic benefit to be gained in educating the American people through radio to an appreciation of the higher forms of culture.

Radio's use in the church and school are also to be demonstrated in special nation-wide programs from scores of stations.

NATIONAL RADIO WEEK is an unselfish, co-operative effort on the part of everyone in radio, from listener to manufacturer, to demonstrate what the new science and industry has accomplished thus far in the brief span of one year of general popularity and to give the listener an insight into the yet unrealized possibilities of the near future. It is an organized effort to add to the ranks of listeners—to double this number in fact.

Every listener will endeavor to enlist one other person as a radio fan. This will double the number of broadcast listeners. Programs from every station in the country, specially prepared to fit the holiday season and the spirit of the week, will be sent out on the air. Sporting events, operas, jazz bands, speeches, and other particularly interesting programs will fill the air. Nation-wide broadcasts of a single event to be heard in every section of the country at once, will be made.

RADIO AGE
"The Magazine of the Hour"
M. B. SMITH
PUBLISHER
PUBLISHED MONTHLY GARRICK BLD'G CHGO.
FREDERICK SMITH
EDITOR

A Homemade Battery Charger for $3.00

By F. D. PEARNE

ONE of the most essential requirements of a radio set is some kind of a charging apparatus which will keep the storage battery charged at all times. This is comparatively easy where the electric lighting circuit is of the direct current type, but unfortunately for the radio fan, most lighting circuits use the alternating current and before a battery can be charged with this current, some method of rectification must be used. Various devices for this purpose are now on the market, some of which are sold at

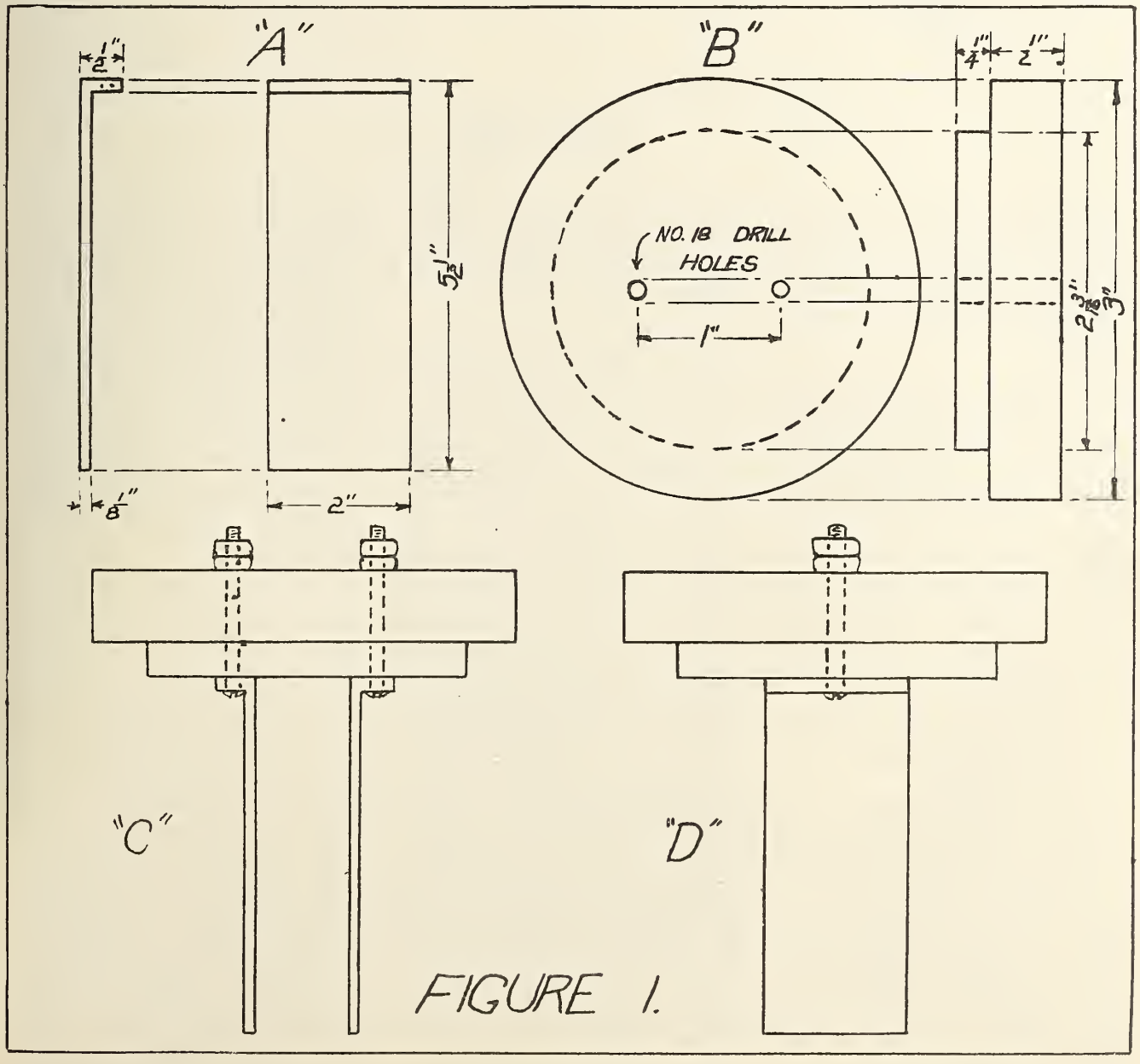


FIGURE 1.

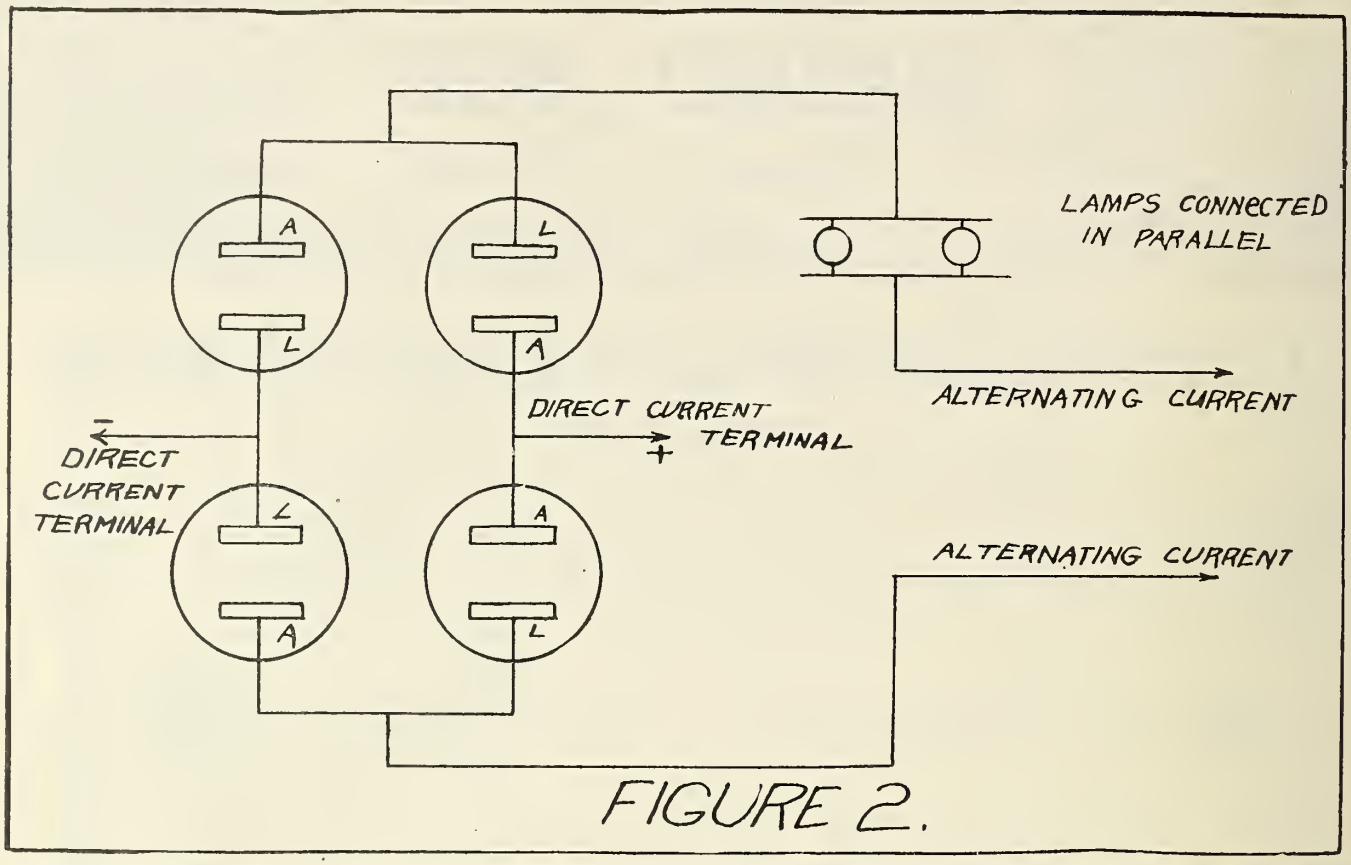


FIGURE 2.

reasonable prices, while others are really expensive, and as the average radio fan usually has plenty of outlets for his spare change, I am going to describe a rectifier which any amateur can build at an expense of less than $3.

This outfit is known as the "Noden valve" and will answer the purpose very well and in fact is really better than some of the rectifiers one may buy, for the reason that it rectifies both sides of the alternating current wave, which some of the standard outfits do not do. The materials required consist of four ordinary quart size mason jars, such as are used for putting up preserves; four pieces of sheet aluminum one-eighth of an inch thick; four pieces of sheet lead of the same size and thickness, four wooden tops to cover the jars, a few brass machine screws and nuts, and about two and one-half pounds of phosphate of ammonium.

First cut out four plates of good, soft sheet aluminum, six inches long, two inches wide and one-eighth of an inch thick. Bend one end over, one-half inch as shown at "A", Figure 1. Drill a hole through the center of the part which is turned over. This should be drilled with a No. 18 drill which is large enough to allow an 8-32 brass machine screw to pass through it. These plates should be made of soft aluminum for the reason that hard aluminum will crack and break, if bent at a sharp angle. Next cut out four pieces of sheet lead of the same size and shape as the aluminum pieces, and drill holes of the same size in the same place.

The wooden tops for the jars should be turned out of hard wood. The flange should be three inches in diameter and one-half inch thick and the smaller part is two and three-sixteenths inches in diameter and one-quarter inch thick. This small projection is to extend down into the jar and will just fit into the neck of the quart-sized fruit jar. If any other kind of a jar is used, this size should be changed to suit the case. If it is not convenient to turn these tops out in a lathe, they can be made of two pieces cut out with a jig saw and fastened together with screws, but these screws must be so located that they do not interfere with the holes which are to be drilled, as shown at "B', Figure 1. Now mount one aluminum plate and one lead plate on each of the tops as shown at "C," Figure 1. These plates are held in place by 8-32 brass machine screws, one and one-half inches long and fastened with a nut on the other side. The nut should be turned up very tight so that the plate is held rigidly in place. Another nut on top of the first one serves as a binding post to which the wires will be connected later.

After all four units are complete the part of the plates which was turned over, as well as the screw heads and the part of the wood which goes down into the neck of the jar should be coated with melted wax, or paraffine to prevent any gas or fumes from the solution corroding the screws, thereby causing a poor joint. Next, make up the solution with which the jars are to be partly filled, make a saturate solution (all the water will dissolve) of distilled water and phosphate of ammonium. It is necessary that the distilled water be used as it will not work if the water contains any impurities.

Fill the jars with this solution to within about one inch of the top, that is, the solution should be within one inch of the top when the plates are in the jars. It is a good plan to measure out enough water to fill the jars three-quarters full and then add the phosphate of ammonium, until no more can be dissolved. In dissolving this chemical, it should not be stirred with a metal spoon, use a piece of glass, so as to make sure that no impurities get into the solution. Figure 2 is a diagram of the circuit, which shows how the connections are made. The aluminum plates are marked "A" and the lead plates are marked "L" respectively. Lamps are connected in the circuit, which allow only a certain amount of current to pass from the alternating current wires to the rectifier. Each lamp added in

(Continued on page 28.)

Radio Receiving Equipment*

By FRANK CONRAD

Assistant Chief Engineer, Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.

THIS paper is intended to discuss questions of design of those types of receiving apparatus which are adapted for reception over a limited range of wave length, and which depend for their operation on such manipulation as can be successfully carried out by persons entirely unfamiliar with the technique of radio apparatus. Their principal field of application is the reception of broadcast radio telephone signals.

Among the many requirements which an ideal receiver of this class should fulfil are that:

(1) It should tune in the wave length desired with only simple adjustments, which should not interact on each other. With a signal of normal audibility from a desired station, the signal strength from another equal or possibly more powerful station, separated by ten thousand cycles, should be below audibility.

(2) Its sensibility should be such that its range will be limited by static interferences, fading, and so on, rather than by actual lack of response. Any local sources of power necessary for its operation should require infrequent attention.

The first-mentioned requirement, which may be termed selectivity, is more or less fulfilled by giving the receiver a characteristic in which its impedance to the desired band of wave length is very low in comparison with its impedance to the wave length above and below this band.

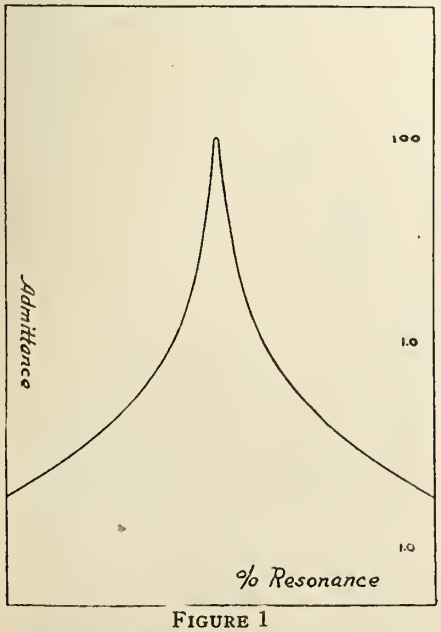


FIGURE 1

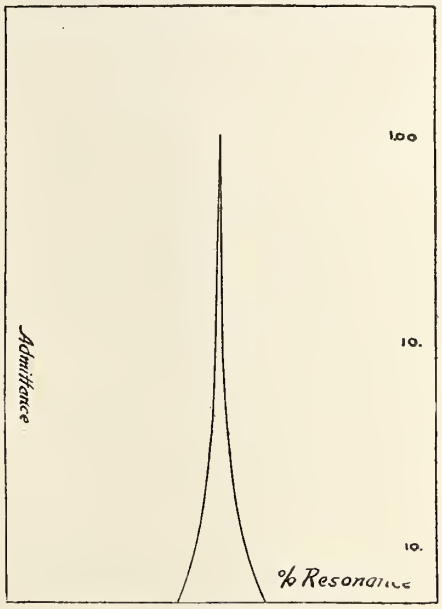


FIGURE 2

The curve in Figure 1 shows the relation of admittance to wave length in a simple oscillating circuit which has the constants of the antenna ordinarily used and which is tuned to a definite wave length by the addition of a variable inductance.

An examination of this curve shows that, although the maximum signal is obtained for the wave length to which the circuit is tuned, appreciable response is given to wave lengths differing considerably from those for which it is in resonance.

In order to obtain the desired selectivity, it is necessary considerably to increase the time constant of this circuit. This result can be accomplished in one or both of two ways: namely, by increasing the inductance element with a corresponding reduction, of capacity, or by decreasing the effective resistance by regeneration.

The curve in Figure 2 shows the effect of placing an additional capacity of 25 micro-microfarads in series with the circuit with a corresponding increase in inductance to bring the circuit in resonance with the same wave length as under the first condition. It will be noted that the selectivity is very considerably improved.

In the case of a vacuum tube detector, which is nominally a voltage-operated device, the large inductance implies a correspondingly large voltage available for operation of the detector, with the resultant increase in signal strength. In the case of the crystal detector, the maximum signal strength is obtained when the effective resistance due to the detector is equal to that of the balance of the antenna circuit. It, therefore, should be connected across such part of the inductance as will give the best compromise between selectivity and sensitivity.

The use of the regenerative vacuum tube offers the further possibility of increase of selectivity with the additional advantage of a very marked increase in sensitivity.

The curve, Figure 3, shows the relation of admittance to wave length of the same circuit as that for Curve 2, with the exception that the resistance element is assumed to be one per cent of that in Figure 2. This is an amount of regeneration which can readily be obtained. The ordinates of this curve are drawn to a scale one hundred times that of Figure 1 and 2, and it might be assumed that the signal strength would be one hundred times that which would be obtained from the circuit of Figure 2. This condition does not necessarily follow, owing to the fact that there is a definite limit to the component of antenna current which is proportional to the incoming signal.

This condition may be illustrated by the diagram, Figure 4. In this diagram, *O E* represents the incoming signal field affecting the receiving antenna. Should the impedance of the receiving antenna circuit be infinite, the voltage induced in this circuit will be in the phase *O C*. For finite values of resistance impedance in this circuit, the current will be bounded

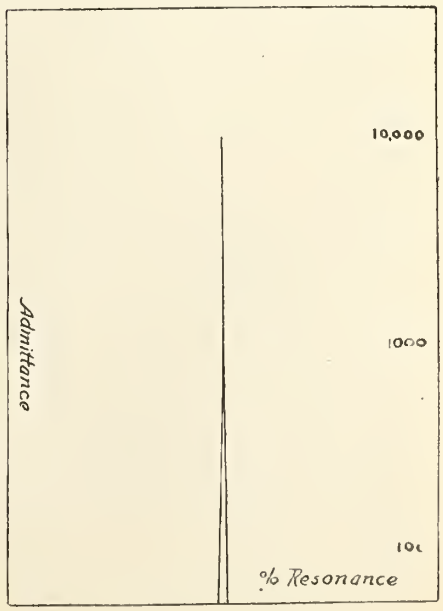


FIGURE 3

*Presented before The Institute of Radio Engineers, New York, October 4th, 1922.

by the circle *O B A*. Thus, for a given value of resistance impedance, the current will be represented by the line *O B*. The field surrounding the antenna due to this current will have the same phase and relative length, and the total effective field will be the sum of *O E* and *O B*, or *O D*. For zero resistance the current will have the phase and relative length *O A*, with a zero resultant field. Further consideration will show that this ultimate received antenna current is independent of the height of the antenna, provided all sections of its length are affected by the same field intensity, it being dependent only upon the field per unit length.

The antenna therefore may be considered as a constant voltage generator, having a definite internal impedance, which is proportional to antenna height. This generator supplies a load circuit having the constants of the oscillating circuit.

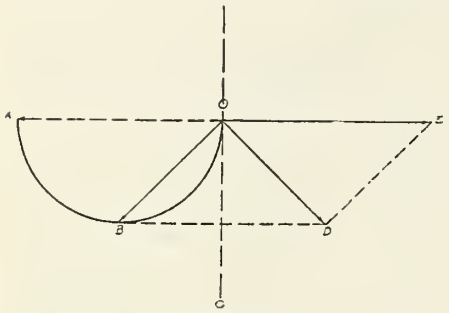


FIGURE 4

In the case of a regenerative system in which the regeneration is carried out to such an extent as to produce oscillations, the current due to the incoming signal will be super-imposed on the local current, and have a value dependent entirely upon the effective resistance but independent of any local oscillating current.

Figure 5 shows the conditions determining the resistance of the antenna circuit under the oscillating condition. In this curve the line *G* shows the relation of voltage impressed on grid terminals to the oscillating component of plate circuit. Curve *P* shows the oscillating component of plate circuit set up by this impressed grid voltage. From this curve it will be seen that, once the oscillations are started, they will increase to a point where the curve *P* intersects the line *G*. The effective resistance of the antenna circuit is determined by the relation of the angle of this intersection to the angle of *G* with the base. In actual practice, it is possible to reduce the angle of intersection at this point to such a value that the antenna current due to incoming signal will closely approach the ultimate value. Any possible increase of the sensitivity is therefore limited to an increase of the inductance across which the detecting circuit is connected. The extent to which this increase can be carried out is largely a matter of design.

The limitation of sensitivity due to ultimate antenna current also imposes an apparent reduction in selectivity and is a feature which usually is not considered in the discussion of the oscillating circuit.

Referring to the curves, Figures 2 and 3, these show the characteristic of simple circuits made up of capacity, inductance and resistance. In the case of an actual antenna circuit, it has been shown that there is, in addition, a limiting impedance which is proportional to the height. In the consideration of the sharpness of tuning the antenna circuit, it is necessary to consider this limiting impedance in addition to the actual impedance of the oscillating circuit. Therefore, the actual increase of sharpness of tuning which can be obtained by regeneration is largely determined by this limiting impedance, or, in other words, by the antenna height.

In Figure 6 are shown two curves taken with similar receiving sets, but on antennas of different heights. The left-hand curve is from a single-wire, inverted-L antenna, having a height of 35 feet (10.6 m.) above ground, and a length of horizontal portion 75 feet (23m.). The right-hand curve was taken from an antenna having a height above ground of 15 feet (4.6m.), the length of horizontal portion being the same. The same receiver was used in each case.

These two curves show the very great increase of selectivity to be obtained by the use of the low antenna. In fact, the increase is considerably greater than would be expected from consideration of the comparative heights of the two antennas. It is probably accounted for by the condition that the effective height of the lower antenna is a considerably smaller percentage of its actual height than in the case of the higher antenna, owing to the indefinite height of the ground connection which was made to the hot water heating system, thus giving an effect equivalent to raising the height off the actual ground.

Due to the absorption by objects on or near the ground, it is usually impossible to realize completely the condition of equal signal strength with low as with high antenna, and of course the possibilities in this direction depend on the surroundings of the antenna in question.

Under conditions in which the reduction of signal strength with height is due, as is often the case in thickly built-up districts, to the appreciable absorption near the ground, it is possible to improve the selectivity of the antenna by the use of a coupled secondary circuit in the receiving set. If another resonance circuit of the same constants were connected to the output circuit of a vacuum tube amplifier connected to a resonance circuit having the constants corresponding to that of Figure 2, the characteristic of this double circuit would be proportional to the product of the characteristic curves, which, it is evident, would give a very greatly increased selectivity.

This arrangement constitutes the ideal method of improving the selectivity of a receiver. If, in place of the relay coupling between the oscillating circuits, a direct coupling were used, the relation of the secondary to primary would, in a sense, be a duplicate of that existing between primary and the transmitter, with the equivalent antenna height of secondary corresponding to the looseness of coupling, thus permitting the possibility of a receiver connected to a high antenna and with the selectivity of a low one. However, the extent to which this can be carried out is limited by the fact that, as the apparent secondary antenna height is reduced by reduction of coupling, the reduction of primary resistance by regeneration is also reduced, with a corresponding limitation of ultimate secondary signal current and its attendant reduction of selectivity.

Owing to the difficulty of carrying out the necessary interacting adjustments, the use of a coupled circuit receiver is justified only under those particular conditions in which it is not possible to take advantage of the selectivity of the low antenna.

A further possibility towards the solution of the receiver problem for congested districts is the use of a closed coil or loop in place of an open antenna. The loop receiver will have the advantage that, similar to the short antenna, it embraces a limited field area, and at the same time can usually be placed sufficiently above ground level to be in a somewhat denser field than would be the case with a corresponding short, open antenna. The limiting impedance of the loop is comparatively low, but as the induced signal voltages are also low, it is necessary that a regenerative system be used in order to obtain the benefit of selectivity. It, of course, has certain possibilities of eliminating interference, due to its directional properties. In general, the loop receiver under its best conditions, will give results which are practically identical with those obtained from a receiver connected to a properly proportioned, open antenna, barring, of course, the possibility that the relative position of the interfering station may be such as to permit of advantage being taken of the directional effect. It has the advantage of convenience of installation and of not being restricted to location as regards height where the field density may be low. How-

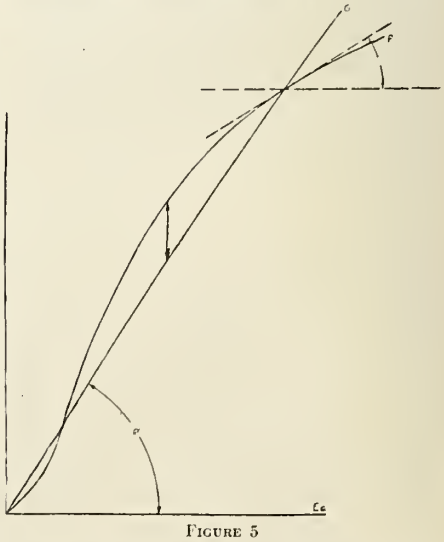


FIGURE 5

ever, the first cost and maintenance expense of such a receiver are far greater than those of the equivalent regenerative set on an open antenna, and for these reasons, cannot, at the present time, be considered as a real competitor of the open antenna receiver.

The foregoing conclusions in regard to the conditions effecting selectivity are based on the premises that the receiver is used for the reception of modulated continuous wave signals and that the inter-

ferences to be dealt with are those set up by similar transmitters.

In the case of interference resulting from atmospherics, or static, the particular precautions which would minimize interference from other transmitters would have insignificant effect, and at the present time there is no practical scheme which gives any appreciable reduction of interference from static.

In the case of interference from damped wave transmitters, the effects will lie between the conditions of a modulated continuous wave signal and static, the similars to one or the other being determined by the decrement of the interfering signal.

In the case of the usual amateur spark transmitters, which is the one most likely to set up the interference, the conditions will be not far removed from those governing the effects of static, owing to the usual high decrement of these transmitters.

The solution of the problem of interference from this source should be in the direction of elimination of the spark transmitter by the substitution of continuous wave sets, rather than by any receiver development, owing to the actual great width of wave band covered by even the best type of spark transmitter.

The one serious defect of the regenerative receiver is the interference it can produce on other receivers due to radiation when regeneration is carried to the oscillating point. The intensity of this radiation can be controlled to a certain extent by the antenna circuit constants and the constancy of regeneration of the receiving set with various wave length adjustments.

With increase of inductance element in the antenna circuit, the antenna current for a given voltage applied to a receiving tube is correspondingly reduced, with attendant reduction of interference; and, with constancy of regeneration with varying wave length adjustment, the possibility of the set producing strong oscillations during the tuning operation will be reduced. This latter feature has considerable bearing on the system of regeneration which it is advisable to employ.

The mechanism of regeneration implies a coupling between anode circuit of tube and oscillating circuit, such that any fluctuations in anode current sets up corresponding oscillations in the oscillating circuit, and of such phase relation as to reinforce the original oscillations which had acted on the grid of the tube. This coupling may be electro-magnetic or electro-static.

In the electro-magnetic coupling a coil which is in series with the anode circuit is so disposed that its field embraces more or less of the inductance in the oscillating circuit.

With the electro-static coupling, advantage is usually taken of the capacity between grid and anode elements of the tube and its connections. When the impedance of the anode circuit is altered by a varying grid potential, corresponding potentials are induced on the grid element through the capacity of tube and connections. When the grid is connected to a resonant circuit and the impedance

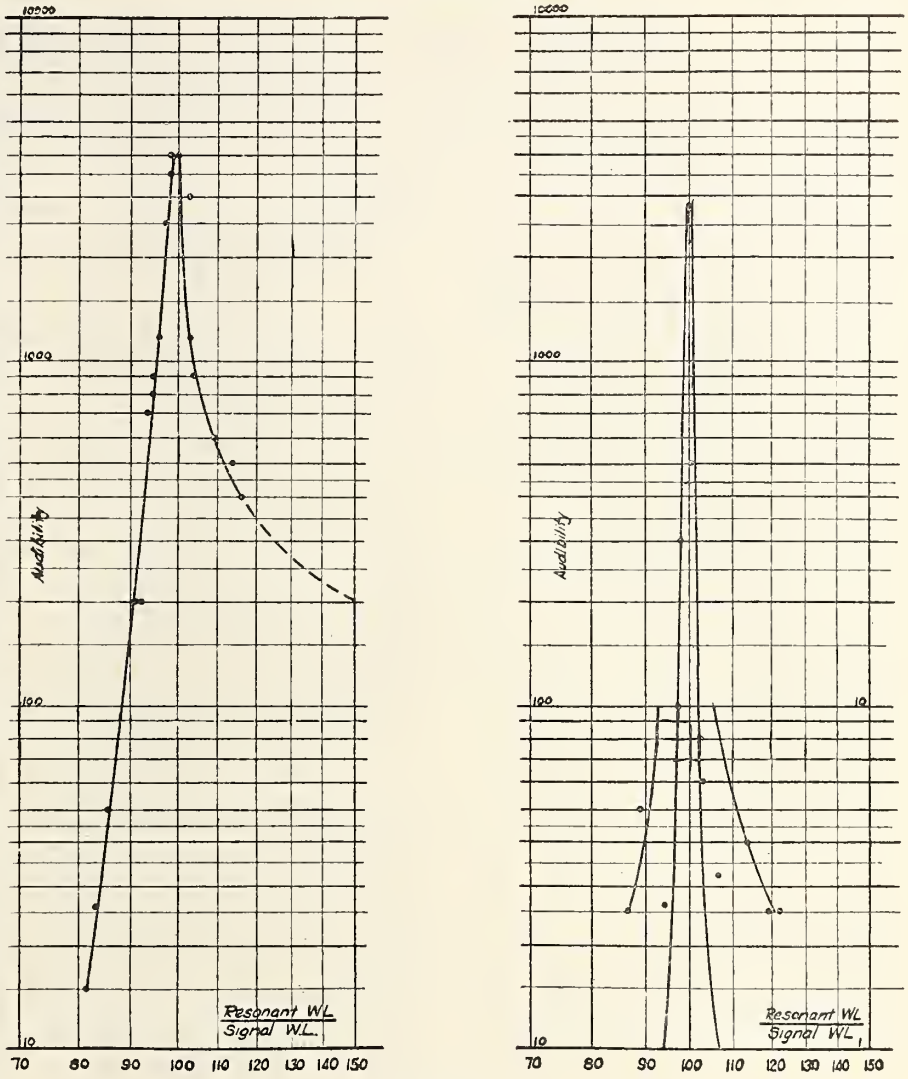


FIGURE 6

in the anode circuit is principally a resistance, the phase relation of induced potential on grid through anode is 90 degrees displaced from the original controlling potential of the grid. An inductive reactance in the anode circuit so shifts the induced potentials that it assists or adds to the potential grid controlling potential. A capacitive reactance so shifts the phase relation that the induced charge grid subtract from the original controllings potential. Therefore, by incorporating a variable inductance in the anode circuit, the amount of regeneration can be controlled at will.

The inductive coupling method of regeneration possesses the advantage that when the anode coil is coupled to the variable inductance which controls the wave length of the oscillating circuit, the amount of regeneration remains practically constant over an extended wave length band. In the case of the capacitive coupling, both the effect of capacity between anode and grid circuits and the effect of inductance in the plate circuit vary with change of wave length. The regeneration, therefore, requires readjustment with each readjustment of wave length of the set. For this reason the operation of tuning-in a signal is more complicated. The inductive coupling method, however, requires proper proportioning of the relation between coupling coil and turning inductance, while the capacitive coupling merely requires the insertion of a variable induction in the anode circuit and the necessary by-pass condensers to shunt the radio frequency fluctuations in this circuit around intertube transformers or telephone receivers. For this reason, this arrangement has been a great favorite with radio experimenters as well as manufacturers of receiving apparatus, who have merely assembled conventional parts in a containing case.

From the standpoint of interference produced by the receiver, therefore, the inductive coupling method is considerably superior to the capacitive coupling, owing to the fact that the coupling can be set at some value below the oscillating condition, which it will maintain throughout the whole range of wave length adjustment. The degree of regeneration which can be obtained over the whole range without oscillations occurring at any point is, of course, dependent upon the excellence of design of the set. In case of the capacitive coupling, as the degree of regeneration increases at a very rapid rate with decrease of wave length setting, it is necessary, in order to obtain any appreciable regenerative ef-

(Continued on page 28.)

How to Avoid Interference

By C. W. HORN
Director of Radio Operations, Westinghouse Electric & Manufacturing Company

IN order to assist radio broadcasting, the Department of Commerce has specified two wave lengths on which broadcasting may be conducted. These wave lengths are 360 meters, the one in general use up to this time, and 400 meters, just recently allotted. While these wave lengths are forty meters apart, undoubtedly there will be considerable confusion on the part of those owning radio receivers who are located very near a broadcasting station.

For the purpose of assisting those who are located so that a 360-meter and a 400-meter station are picked up by their receivers simultaneously a number of methods will be described, which, if applied, should greatly assist those desiring to get either one of the two waves without interference. There is one case, however, which will be very difficult to assist; that is, where the receiver is exceptionally near to a broadcasting station—say within a few thousand yards.

The assignment of two wave lengths so close together will have the effect of stimulating construction of radio apparatus which will be capable of tuning more sharply, and it is the case of "necessity being the mother of invention." Therefore, while there may be some inconvenience at the present time, this should be overlooked in order to help the radio game by creating a condition which will stimulate the construction of better apparatus, and which will permit the assignment of more wave lengths, ultimately creating a better situation in the ether.

One of the greatest faults that has been found in connection with the installation of radio receiving apparatus is that it is believed that the more wire and the larger the antenna the more will be received. An exceptionally large antenna makes it more difficult to tune sharply, and for this reason it is advocated that a very short, single wire antenna, approximately 75 feet long, measuring from the apparatus to the far end, be used. This single wire antenna should be stretched away from all metallic objects and run straight and clear of all obstructions.

Another fault in the installation of receiving apparatus can be eliminated by not running the antenna or lead-in over metal roofs, along water spouts or drains, or parallel to telephone and power wires.

Frank Conrad, assistant chief engineer of the Westinghouse Electric & Manufacturing Company, has made measurements and drawn resonance curves which show that a short low antenna tunes more sharply than a large and long antenna. (See his article on another page of this magazine.) This holds true both for coupled and single circuit tuners.

Another method to pursue in overcoming interference, especially where vacuum tube receivers are used and where the receiver is located close to a broadcasting station, is to make use of the well-known directional properties of the loop antenna. A very simple loop can be constructed by winding a half dozen turns of wire spaced about one inch apart, on a framework, which can be rotated. It will then be easy to tune out a station which has a difference of forty meters in wave length, especially so as a loop antenna forms a closed circuit which can be more sharply tuned than an open antenna. The two ends of the loop should be connected across the antenna, the ground terminals of the receiver, and no other ground or antenna used.

Those who are located a greater distance from a broadcasting station can, without any difficulty, tune in either one of the wave lengths mentioned. They should, however, bear in mind that a single wire antenna, not too long, and kept free from obstructions, and not running near grounded metallic objects, will tune sharper. Where the amateur has a transmitting apparatus it is of course desirable to have a fairly large antenna, with more than one wire, and if such is the case he should use a separate wire for receiving.

The ideal condition will be when stations can operate independently on either of two wave lengths without interfering with each other, and because the receiving apparatus is an important factor these suggestions are given in order that owners or receiving apparatus may have the necessary information to increase the efficiency of their apparatus.

Code-Sender is Sued by Owner Receiving Set

WHO has first right to ether, the radio receiver or the radio sender? This is the problem—entirely now—which is raised in the suit filed by Edward McWilliams of Dwight, Ill., in the Circuit Court at Pontiac, Ill.

The suit is filed against Wiley Bergman, another radio fan of Dwight, who has a sending apparatus. Mr. McWilliams has only a receiving set, and when Bergman is sending he declares that his service, as well as that of the twenty other radio fans in Dwight, is interrupted.

McWilliams wants the court to determine whether one person has a right to send wireless messages into the air, disabling the pleasure of countless other persons while they are receiving prearranged programs from all parts of the country, which fact McWilliams declares Bergman is aware of but refuses to recognize.

McWilliams also asks an injunction restraining Bergman from operating his sending apparatus when programs are being broadcasted by recognized stations throughout the country.

Experts to Meet

At the request of the Department of State, each Governmental Department interested in or having to do with wire and wireless communication has appointed a representative to serve on an inter-departmental committee for the consideration of problems of international electrical communications. At a meeting, soon to be called in Washington, the several members of the United States Committee will study the problems to be considered at the forthcoming international conference to be held in Paris, and the American agenda and policy will be worked out, in detail.

The membership of the committee follows:

Post Office, Mr. Paul Henderson, 2nd Assistant Postmaster General; War Department, Major General George O. Squier, Chief Sig. Officer of the Army; Dept. of Commerce, Mr. P. E. D. Nagle, Communications Expert of this Dept.; Navy Department, Rear Admiral H. J. Ziegemeier, Dir. of Naval Communications. (In his absence Rear Admiral Joseph Strauss will be available for this Service); U. S. Shipping Board, Mr. F. P. Guthrie, in charge of Radio Service of U. S. Shipping Board.

The State Department representative has not been designated.

Questions and Answers

By Radio Age Institute, Conducted by Frank D. Pearne

To insure prompt reply to questions, please enclose self-addressed and stamped envelope.—The Editor.

F. M. P., Chicago, Ill.

Question: 1. I have the September issue of the Radio Age, which shows the Reinartz tuner with two-step amplifier. I would very much like to have it with jacks and plug connections. 2. What does it cost to build an Armstrong super-regenerative set like the one used by Paul B. Coats and shown in your September issue? Do you recommend it to be a good loud outfit for concert stuff on a loud speaker?

Answer: Circuit has been mailed to you. The Armstrong arrangement is quite expensive as compared to other circuits, but this is not the principal difficulty. Sometimes it will work and other times it will not and the general opinion of engineers who have tried it out is that the results obtained are not worth the great trouble of building it and trying to keep it in adjustment, It is plenty loud for short distance work. but is not much good for long distance reception.

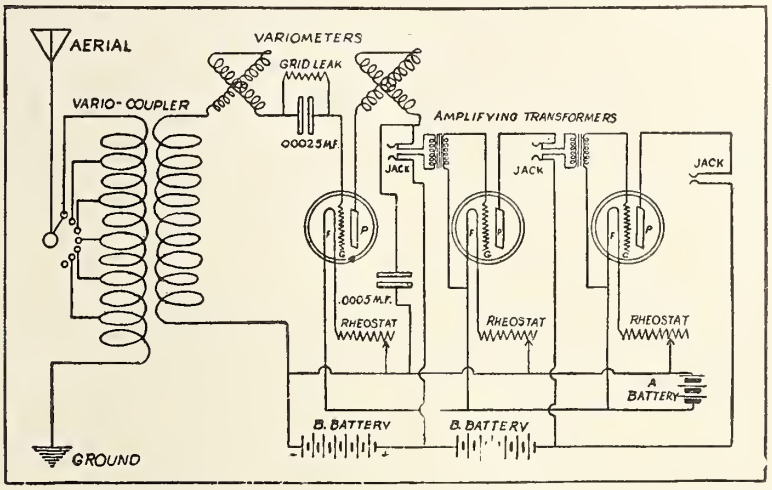
C. A., Streeter, N. D.

Question: 1. I have constructed the Reinartz unit with one-step of amplification as per your instructions and details published in the September issue of the Radio Age. So far I have been unable to make the set work. I made the coul out of No. 26 enamel magnet wire. Is this satisfactory for this work? I was unable to obtain the kind mentioned. I am using a variable condenser instead of the grid leak and condenser. 2. Will it be necessary to use a grid leak between this condenser and where it is connected to the grid connection on the socket. 3. Which wire should be connected to the rotating part of the condenser?

Answer: 1. If you followed the instructions carefully, there is no reason why you should not get results. Thousands of amateurs have made this set and only a small percentage have had trouble in making them work. The wire which you used is all right. 2. I think you would have better luck if you used a grid leak and condenser instead of the variable condenser. I am sending you the detector circuit showing just where to use it. 3. The ground wire should be connected to the rotating part of the condenser. In the case of the aerial condenser, the rotating part should be connected to the aerial.

F. M. J., Waco, Tex.

Question: 1. I am sending you a circuit using a vario-coupler and 2 variometers. I am not having much success with this circuit and I am in doubt as to whether or not it is correct. As you will notice, I am using two-steps of audio frequency amplification but it does not seem to do any good. Will you kindly look over my hook-up and tell me if I am right, and if not, please send me the proper hook-up for this set.



Answer: 1. Your circuit is all wrong, F. M. J., and I don't see how you could keep your batteries up if you used it. I am showing a cut of the correct circuit, with a two-step amplifier.

L. T., Independence, Kans.

Question: 1. Will you please send me a circuit for a sharp tuning, long distance, crystal set if possible. If you can't send it, please let me know where I can get it.

Answer: 1. I am sending this circuit to you by mail. The only reason this is called a long distance set is because the tuning is so much sharper that stations which cannot be heard with an ordinary crystal set can be picked up.

E. O. W., Lincoln, Nebr.

Question: 1. I have a loose coupler tuning coil which I constructed myself. The primary of this coil is seven and three-quarters inches long and three and three-fourths inches in diameter. It is wound with No. 22 enameled wire. The secondary is six inches long and three and one-half inches in diameter and wound with No. 26 single silk insulated wire. Would you kindly send me a vacuum tube hook-up using this coil, with which I could get high powered broadcasting stations of 360 meters, from 500 miles up, distant? If it is possible I would like the apparatus in this hook-up efficient, but inexpensive, as my capital is rather limited.

Answer: 1. I am mailing this circuit to you. I don't know how far you can receive with it, but it is as good as you can get for a loose coupler circuit.

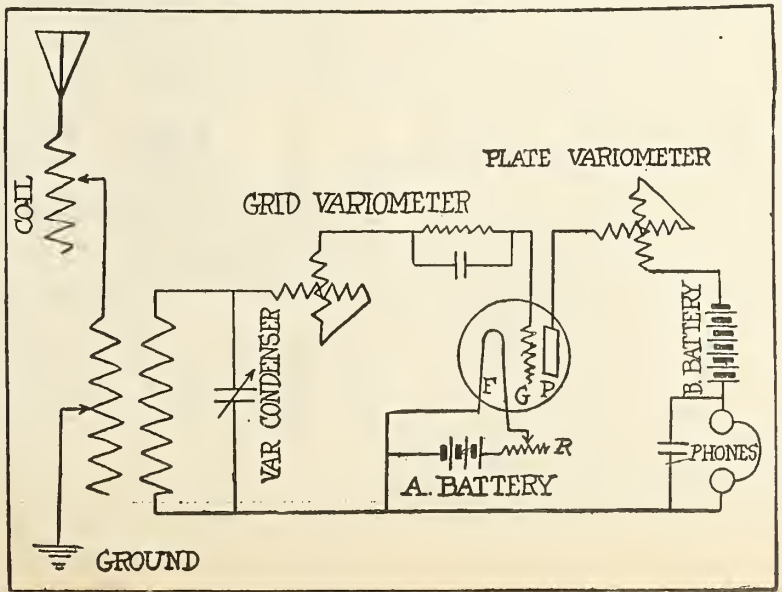
M. O. R., Arcola, Ill.

Question: 1. Will you please send me a circuit showing how to connect a loading coil to a varoi-coupler and variometer set?

Answer: 1. This should be connected in the aerial circuit as shown in the following diagram.

A. K., Chicago, Ill.

Question: 1. I have decided to make the Reinartz tuner which was printed in the November issue of the Radio Age, on page 5. I would greatly appreciate it if you would answer these questions for me. Please give a diagram showing where to place three jacks. 2. Is it possible to use a loop aerial with this set? 3. Can I use a 43-plate condenser instead of 23 plates? Will it make any difference? 4. I used No. 26 S. S.



covered wire for the coil. Is it O. K.?

Answer: 1. I am sending you a rough diagram by mail, as it would be too large for this column. 2. Yes, I have used a loop aerial with mine and while I did not get as many stations as I got with the outside aerial, still I did get very good results. Use about 8 turns on a frame 4 feet square. 3. You can use the 43-plate condenser if you want to, but they are more expensive. 4. The No. 26 S. S. covered wire is all right.

R. N., Chicago, Ill.

Question: 1. Will you please send me a hook-up using the following parts: 1 two-slide tuner, 1 grid leak and condenser .00025, 3 rheostats, 3 V. T. sockets, 1 All American transformer, 10 to 1, 1 Thordarson transformer, 4 to 1, 1 six-volt A battery, and 2 B batteries, 22 1-2 volts each?

Answer: 1. I am sending you this circuit by mail, but I think you would have much better luck if you used a vario-coupler instead of the tuning coil.

H. E. K., Mt. Morris, Ill.

Question: 1. I have read your article in the Radio Age regarding the construction of a Reinartz tuner and intend to make one. As I have a quantity of No. 28 double cotton covered magnet wire on hand, I would like to know if I could get the same results by using it for the tuner. Also would appreciate a diagram showing how to mount the instruments on a panel 8" by 18". This is my first attempt at constructing a set and am a little skeptical as to the results, but from the records made by others, I do not think I can go wrong.

Answer: 1. You can use the No. 28 wire all right, the only difference being that it will slightly increase the resistance of the coils, which I do not think will effect your reception. There is no reason why you cannot be just as successful as others in the making of this set. Will be glad to help you out if you have any trouble.

Club News

A radio club has been formed by the Jewish People's institute, 1258 West Taylor street, where meetings will be held at which the theory and practice of radio will be explained by some of the more expert members of the organization. During succeeding weeks the construction and operation of both crystal and vacuum tube sets will be explained, as well as use of radio frequency and audio frequency amplifiers.

Four Wisconsin radio stations, two at Oshkosh, and one each at Appleton and Berlin, have formed an association, which holds its business meetings by radio. A new station is under construction at Neenah, which will also be admitted to the "Fox Valley Radio Association," as the new organization is known.

Alfred Thomas, Jr., was elected president of the Radio Club of Illinois at the recent election. The newly elected vice-presidents are Paul C. Niehoff, A. H. Kopprasch and Herman J. Pomy; Secretary, John P. Tansey; Treasurer, J. Elliott Jenkins; Directors, Frank D. Pearne, U. J. Herrmann, Thorne Donnelley, E. H. Gager, Charles O. Stimpson, W. L. Holst, Leroy M. E. Claussing.

Zanesville, Ohio, is headquarters of a Radio Association for which a membership of 500 owners of sending and receiving sets is sought. The association held a meeting in the Zanesville Banking & Trust Company recently. John Garrett was named to lead the membership campaign. Team captains in the drive are Ed. Bonnett, Will Fouts, Ed. Garrett, Mike Hellyer, Arthur Jones, Alf Williams.

Two radio clubs, organized and supported by some of the most prominent figures in the Danish field of communications, have recently been formed to promote interest in radio telegraphy and telephony throughout Denmark. The aim of these clubs is to spread knowledge and create interest in wireless communication through lectures, demonstrations, and other means.

Costs Only $25 to Join

Those interested in the organization of radio clubs will find in the following program of activities, issued by the Radio Club of Illinois, some valuable suggestions as to what a radio club can accomplish. The circular containing the information is signed by Alfred Thomas, Jr., President of the club, and John P. Tansey, Secretary.

The functions of the club are outlined as follows:

Our activities in addition to promoting interest in Radio and bringing together all persons similarly interested, for social and educational advantages, are in part as follows:

1. Interesting all concerned in the proposed National Radio Control Bill. All Chicago members of Congress are anxious to serve the best interests of this new industry.

2. Prevent the passage of any regulatory ordinance by the City Council at the present time, and to continually oppose any ordinance providing for Inspection Fees. We claim credit for freedom to date from this abuse.

3. To foster the interests of those engaged in the trade or business of manufacturing radio apparatus and accessories and parts thereof.

4. To reform the abuses relative thereto.

5. To secure freedom of its members from unjust and unlawful exactions.

6. To diffuse accurate and reliable information as to the standing of merchants and others dealing with members with respect to their credit and as to all inventions, patents, processes, or devices designed or intended for use in, upon or in connection with such apparatus and the manufacture thereof, as to the state of the art relative thereto, and as to the condition and development of the trade in which the members are engaged, in the United States and foreign countries.

7. To procure uniformity and certainty in the customs and usages of such trade.

8. To promote radio and carrier wave broadcasting and the quality of such service.

9. To settle differences between members.

10. To promote a more enlarged and friendly intercourse among business men engaged in such trade or dealing with persons engaged therein.

11. A program of lectures, reading of technical papers by recognized authorities, has been inaugurated.

12. Steps for the installation of a laboratory will be taken.

13. Our Club will shortly be in a position to furnish accurate information to our members as to circulation and advertising benefits of Radio papers and magazines. A saving of many dollars will be the result.

14. Necessary steps, and unlimited effort, for the stimulation and encouragement of the Radio industry are an important part of our plans.

15. We will furnish lectures and speakers on Radio, for special occasions.

16. We will endeavor to induce public and social service agencies to install sets in the conduct of their work.

17. Promote installation of Radio in industrial plants.

18. Our Club Rooms at disposal of traveling radioists.

19. Will furnish service by competent mechanics to those in need of same, and will act as an employment exchange for our members.

This Coupon and $2

Cut this out and send to Radio Age, 64 West Randolph Street, Chicago, Ill., and receive this magazine for one year. The regular subscription price is $2.50 per year.

RADIO AGE,
64 West Randolph Street, Chicago.

Enclosed find $2 for which please send me Radio Age for one year.

Name.....

Street No.....

City.....

State.....

Homcharging Your Radio Battery

WHILE there has been some very successful receiving sets developed, operating from dry cells, the great majority of those in use, and likely to be sold in the future, require a storage battery for heating the filament in the detector and amplifying bulbs.

The maintenance and recharging of this storage battery has proved the bugahoo which has prevented many a radio fan, not familiar with the facts, from buying or making a real receiving set with several stages of radio or audio amplification, or both. There is no real reason, however, for this feeling, as any storage battery of reputable make will last for several years in radio service without any attention or trouble, excepting the addition of distilled water from time to time and recharging when exhausted.

It is admittably, however, quite inconvenient and expensive to lug a storage battery to a service station every time it requires recharging, which, in the case of a receiving set employing several bulbs, may be once every week. Fortunately, however, there are many makes of home chargers on the market retailing at a popular price, which enables the radio fan to home charge his battery at practically no expense, and without removing it from the receiving room.

While many of these devices require some electrical knowledge for their successful operation, the majority of them are extremely simple in construction, and can be successfully operated by any one. The most efficient of these home chargers will fully recharge any "A" battery overnight with a current consumption of less than one K. W. hour, which, based on the average cost of electrical current throughout the United States, amounts to but 5 cents.

In the purchase of such a rectifier it is important that the buyer consider the following points:

One—Self-Polarizing Feature: With a rectifier of this type battery may be connected either way and will always charge. Otherwise, it requires considerable knowledge and skill to determine proper battery and rectifier polarity, and should battery be connected the wrong way, it is likely to be ruined, or, at least, seriously harmed through reverse charging.

Two—At Least a Five Ampere Charging Rate: With a charging rate of five amperes or more any battery of eighty ampere hour or less capacity may be fully charged overnight. Where a lower charging rate is employed a correspondingly greater time is required. For instance, with a rectifier delivering but two amperes about fifty hours continuous operation is required to fully charge a battery, during which time, or course, it is impossible to use the receiving set.

Three—Underwriters' Approval: The National Board of Fire Underwriters are becoming more strict in the enforcement of rules covering the use of only approved electrical apparatus. Any rectifier having the Underwriters' approval has been carefully tested by them and possesses practically no fire hazard. Considerable difficulty may be experienced in effecting an adjustment with the insurance company in case of fire, if the rectifier you are using has not been approved by them.

After your rectifier has been pure chased, it is advisable to secure a hydrometer from your dealer for telling when your battery needs recharging. This instrument can be purchased for 50 cents to $1.00, and will pay for itself many times over through elimination of unnecessary charging.

A new storage battery should always be given an overnight charge before being used, since it has most likely been several months since recharged at the factory.

Maximum receiving range and strong, clear signals are obtained best when your battery is fully charged. For this reason it is always well to keep your battery in as near full charged condition as possible.

By taking a hydrometer reading after an evening's use of your receiving set, if the specific gravity of battery is below 1200, it is best to connect home charger and charge battery overnight. It will then possess maximum power, be ready for a long period of use, and will bring in the signals stronger and increase the receiving range of your set.

Why Crystal Sets Sometimes Pick Up The Far Calls

QUITE often we hear some radio fan tell of some case of particularly long distance reception with a crystal set which does not seem possible.

However doubtful such a statement may seem to be, one must not be too quick to challenge the statement, for there are what is known as "freak periods" during which time great distances may be covered by the most simple type of receiving sets.

When these periods do appear which is usually in the Winter time hitherto quite impossible distances may be heard with ease.

The origin of these freak conditions in radio reception is not known, but many theories have been advanced, one of which is the fact that daylight always produces some heat, which may cause radio waves to be absorbed more during the day than at night.

This is one explanation of the reason for better reception at night than in the daytime. There seems to be a wild desire on the part of the normal radio fan to hear long distance stations and he will work hard to tune out some perfectly good program coming from a nearby station if he thinks there is any chance of hearing a few words from some city a thousand miles away.

New Loud Speaker

The radio public are giving an ever increasing amount of attention to the loud speaker. Just as the phonograph attained lasting popularity through its ability to entertain a room full or even a recreation hall filled with guests by the use of a single amplifying horn, so it is conceded that for the average owner of a radio receiving set a loud speaker will sooner or later be considered a necessity.

Put briefly, the general requisite of a really good loud speaker, according to one authority, is one that will give "faithful tone reproduction, from which noise and static disturbance are practically eliminated, with volume enough to satisfy the most exacting requirements."

While admitting that this is a "large order," officials of the Planet Radio Corporation announce that in the Planet Loud Speaker they have fulfilled nearly 100 per cent of the above mentioned requirements.

In giving the specifications of the Planet Loud Speaker, an official of the company outlined the principle behind its manufacture as follows:

"The Planet Loud Speaker is made of solid, specially prepared bell metal alloy, which assures clear tones. It is of patented, special shape and construction, *cast all in one piece*, and is far superior to horns made of sheet metal or tin. The wiring, cabinet work and other details of construction are of the highest quality. The Planet Loud Speaker can be attached to any standard two-stage amplified receiving set.

"The Planet Loud Speaker is distinctive in appearance. It is compact and ornamental, a complete unit it itself The case is of mahogany, with a beautiful piano finish; the emitter is burnished and the connecting cord silk covered."

The same company also is offering a loud speaker called the "Plan-O-Phone" which sells for $3.50 and may be used with any two-stage amplified receiving set. It is of statuary bronze and fits any receiver.

The Planet Power Amplifier, made by this company, is a complete unit of beautiful design in a richly finished mahogany case and polished emitter with gold or aluminum finish. It adds loud, clear and distinct reproduction to the sound, transforming the set into a delightful musical instrument.

What Radio Is Doing for Ohio Farmers

(By Ohio Division of Markets.)

Among the many factors which have entered into the improved conditions surrounding the management of the farm in Ohio is the installation of the wireless telephone. Its possibilities have just begun to be realized and they are infinite and endless. A visitor at the office of the Ohio Division of Markets, of the State Department of Agriculture, during the past week said:

"I am now getting my prices on live stock and other commodities every day over the wireless and it has proven a great help to me. I live on a farm and deal somewhat in cattle. In this way I am able to keep in touch with the market and find it of great advantage in buying and selling stock. I know at just the hour the report is coming and all I need do is be at my receiving instrument and I can catch them as they come in from the sending station at Dayton, giving quotations and market conditions from the principal market centers of the country."

This man is no exception to many others throughout the state, as a canvass made by the Market Division has shown. There are now five sending stations, well distributed throughout Ohio. They are located at the Electrical Engineering Department of the Ohio State University, Columbus; the Rike-Kumler Company at Dayton; the Wm. B. Duck Company at Toledo; the Union Trust Company at Cleveland, and the White Radio Laboratory, Stockdale, Pike County.

The area covered by these varies according to the strength of the sending instrument, but there is not a nook or corner of the state into which the reports do not go. Many places outside of Ohio, located in other states, are also receiving the reports, particularly in Indiana, Michigan and Pennsylvania. Farmers and dealers show their appreciation of the service by sending congratulatory messages.

The wireless has just begun to play its part in the betterment of marketing facilities. What it can and will do is no longer a matter of conjecture, but a certainty. It will be but a short time before every progressive farmer in the state has installed a receiving instrument, as a large number of them have already done. Then he will be able to sit in the quiet of his home and catch the prices on the commodities he has to sell or wishes to buy as they come through the air and are given to him by his wireless phone. He can keep in daily touch with conditions in every part of the country and know to a nicety just how things are going. If he is away or at work in the field the good wife can take the report for him and he can get the information upon coming to the house. His calculations can be made accordingly. It places another very important spoke in the wheel of progress, as it revolves on the farm.

One enterprising farmer in the northern part of the state has gone a little beyond his neighbors. He has placed a large amplifier on his instrument and it covers a considerable territory in the countryside. All this ambitious man need do is to sit on the handles of his plow or stand at leisure in the field and the report is wafted to him. If the conditions warrant he can hurry to the nearest market and make a sale or purchase as best suits his fancy. Surely, as the colored parson said, "De world do move."

But to the farmer who has no receiving instrument the broadcasting system renders a valuable service. There is hardly a farm house in these days without a telephone, and probably not a town or community center without a receiving instrument, which can pick up the report. The farmer, if he has the will, need but go to the phone and call the proper number in the nearby village.

"What are the quotations and market conditions today?" he can ask and the answer will be given him without delay. If he has no telephone, the chances are he has an automobile, or, at least, a horse and buggy. Should he be so unfortunate as to possess none of these, he can go back to nature's first means of transportation and walk. In any event, it requires but a little energy and the exercise of no ingenuity to get the news.

Bankers are playing a very important part in the developments of this wonderfully helpful work in the vicinity bordering on Cleveland and Cuyahoga county. A large number of financial institutions in the cities and towns there have installed receiving equipments. They catch the daily reports. As a goodly portion of their patronage is in the rural districts the farmers avail themselves of the opportunity of securing the news, which plays so large a part in the successful transactions of their business. They call by phone or in person, and keep in closest touch with the markets, the prices and the conditions.

Farm agents, in the different counties, acting under the direction of the Extension Department of the College of Agriculture at the Ohio State University and the Ohio Farm Bureau Federation are placing receiving equipment in their offices. Soon all will have done so. There are meeting places for the farmers in the community. They can come in, as they like to come, chat with their neighbors, receive the reports and perhaps secure information which will make them a tidy sum or forestall a transaction that might have entailed a loss. If they cannot come they still have the home telephone as a transmitter of information.

The broadcasting system of market reporting, in which Ohio leads, is playing a most important work in modern farming and farming methods. It is daily growing in usefulness and performing the fundamentally gracious act of service. More and more it will continue to do its good work until eventually every farmer will garner the reports daily in the stronghold of his home.

Crop Service By Radio Now Covers World

A WORLD radio crop service has been established by the United States Department of Agriculture. The Department has representatives in many important European cities, who send reports of crop conditions to Washington. The information is then broadcast by radio over the United States. A recent message from the Berlin representative was received in Washington and relayed throughout the country in less than five minutes from the time the news left Germany.

In return, radio dispatches on crop conditions are sent each week from the Navy Department stations to the International Institute of Agriculture at Rome and to other agricultural centers abroad.

"The World Do Move"

"Aeronautics and the radio telephone are perhaps the most marvelous developments of a marvelous age," said Rear Admiral Wm. A. Moffett, Chief of the Naval Bureau of Aeronautics, speaking over the radio phone from NAA, Arlington, a few nights ago.

Admiral R. E. Coontz, Chief of Operations, who also broadcasted a speech in the interests of the recent Marine Exposition in New York, said that among its activities the Navy Communication Service handled three and three-quarter million words by radio for the American Merchant Marine in the past year.

"During the winter months," he said, "the naval Communication Service handles on an average of 30 S.O.S. distress calls per month, or one a day." That the value of this service to the American public as a whole, and to shipping interests in particular, cannot be overestimated, he insisted.

He also mentioned the developments of the radio compass or direction finder, and stated that the Navy has established stations equipped with this apparatus at various points along both coasts of the United States near the entrance to harbors. When a ship is approaching one of these harbors in a dense fog and is uncertain of her position, all that is necessary for her now to do is to ask two or more radio compass stations for her bearing, he explained.

The Crosley Weekly

The Crosley Manufacturing Company of Cincinnati, publishes a 4-page weekly, containing news, detailed broadcast programs from Station WLW and advertisements. It is a unique "house organ" and has a wide circulation.

Uncle Sam is a Busy Broadcaster

THESE days when 573 private broadcasting stations are offering daily programs, the radio public is likely to lose sight of the fact that its Government is also broadcasting information on many subjects. Six Departments are scheduled for daily or semi-weekly programs and 42 Naval radio stations are carrying news of one sort or another.

Requests for permission to broadcast have become so numerous that the coordination of all Government broadcasting has become necessary. A committee of twelve officials, representing as many branches of the Government at Washington, is endeavoring to supervise matter submitted for public broadcasting over radio telephone circuits furnished through the courtesy of the Navy Department. In order that the listeners-in may receive the maximum service with a minimum of interference and without duplication, this committee was appointed last spring at the suggestion of Secretary Hoover. It is known as the Inter-Departmental Advisory Committee on Radio Broadcasting. Although the committee meets bi-weekly, its sub-committees are busy almost continually with this work.

Demands for broadcasting of telegraph matter, as well as telephone, are constantly increasing, and the scope of the committee's work is gradually growing greater. Recently the question of broader activities and supervision has arisen, due to the frequent requests for investigation and advice on matters other than telephone broadcasting, originally the committee's sole function. Extension of activities is understood to have been generally approved by the different departments so as to cover the subject of radio communications, and the matter is now before the Secretary of Commerce for further action. It is quite probable that this committee will eventually become the statutory advisory committee provided for in the radio bills sponsored by Senator Kellogg and Congressman White.

Activities of the committee to date have made possible the broadcasting of several interesting programs from NOF, the Naval radio station at Anacostia, which is primarily the experimental radio station of the Navy's Bureau of Engineering. The Anacostia station, however, cannot carry the load and does not operate on Saturday afternoon, due to other official duties. As soon as arrangements are completed, all radio telephone broadcasting for the Government will be transferred to the big Arlington station.

Last spring, when the popular demand for broadcasting reached its height, so many official and semi-official requests to use NOF were made of the Naval Communications Service that Secretary Denby could not grant them all; in fact, he finally ruled that only official messages could be transmitted. At one time NOF was closed to all except the highest Government officials. Suggestions, that an inter-departmental committee be appointed to pass on broadcasting and supervise its operation, made by Secretary Hoover, therefore, were welcomed by the Navy Department, and the Committee began to function on June 1. Matter submitted for broadcasting is inspected and methods of operation arranged by sub-committees which attend to all details, determining the value and demand for particular broadcasts.

Applications for broadcasting by the Interior, Agriculture, Labor, Treasury, Commerce and War Departments, have been approved by the committee and fixed schedules, giving each applicant a maximum service of three fifteen-minute periods each week, have been put in operation. Many listeners-in throughout the country have undoubtedly heard the evening lectures and band music over the NOF phone on 412 meters.

On Monday, Tuesday and Thursday evenings, The Treasury Department broadcasts the activities of the Public Health, Internal Revenue and Savings Bureaus. The Commerce Department's schedule on Tuesday and Thursday evenings includes information on foreign and domestic markets, trade news, and fisheries. Talks on immigration, women's activities and child welfare are made on Monday, Tuesday and Thursday evenings by officials of the Labor Department. The Interior Department furnishes lectures on education and mining on Monday and Thursday evenings and Tuesday afternoons.

Information pertaining to crops and weather is transmitted every Monday, Tuesday and Thursday evening by the Agriculture Department. Officers of the War Department will shortly broadcast a series of talks on military activities and recruiting on Monday evenings. Sometimes special broadcasts are arranged for national associations, such for example as the series of speeches on Naval Activities by officers of the Navy, requested by the American Marine Association, during its exposition in New York. The evening programs are so grouped as to make a compact schedule and not interfere with private broadcasting. Each week the programs will be announced by the Navy.

The opening of NAA at Arlington as the official Government broadcasting station has been delayed due to difficulty experienced in operating on the lower Governmental wave band designated for telephone broadcasting. Very soon the Arlington station will open two telephone broadcasting circuits. It is a very busy station and it is necessary to operate several circuits simultaneously without interference. NAA's new broadcasting telephone set of 750 watts, which has just been installed, operates very successfully on the 2050 meter wave telephone circuit, using the main antenna, but does not give good results on the Government's 490 wave, due to reactions between other sets when in use.

For this reason, the sub-committee on technical matters has been requested to consider the use of a wave length of 430 meters in this work and, if it is approved, special permission will be requested of the Commerce Department for its use, since it lies in the band assigned to private and toll broadcasting. The lower wave length is believed necessary so that the service will be available to the people who do not own sets capable of picking up the long 2050 meter wave.

Telephone broadcasting for the departments is not the only work handled by the Naval Radio stations; many messages are also broadcast in telegraph code. NAA carries 10 telegraph broadcasting schedules daily, totaling 30 hours each week, and comprising chiefly quotations on foodstuffs for the Agriculture Department, which approximate 35% of its total day work. NAT, the Naval station at New Orleans, broadcasts two schedules a day, aggregating four hours a week, and the Great Lakes station, NAJ, carries 18 daily schedules, constituting 36 hours a week.

In addition to this matter, twelve Naval stations broadcast two time signals daily; twenty, carry hydrographic information; 37 transmit weather forecasts; and six broadcast press matter. Sandwiched in between these many schedules, the Navy carries on its own official communications, as well as many for the State Department, to ships and foreign stations, and conducts its experiments.

A glance at the operating schedule of any Governmental radio station will explain why the Government requires the service of the Inter-Departmental Committee in an effort to simplify and standardize Government broadcasting. Uncle Sam is generous with his information but he is also generous with the means for transmitting it to the country at large.

Radio Saved the Day

For the first time in history, radio telegraphy was utilized on November 8 to transmit a full press association news report across the Continent. Due to severe sleet, snow and wind storms in the Rocky Mountain region and the crippled service on land lines, the International News Service transmitted a full election service from New York to San Francisco by radio through the cooperation of the Radio Corporation of America. While the usages of radio have increased greatly in the development of recent months, never before has trans-continental transmission been attempted on such a scale. Under the stress of a great emergency, the International News Service report was transmitted efficiently to the newspaper offices in San Francisco and was as fast as that obtained over land lines under ordinary conditions.

Radio Cheers Remote Log Camps

WASHINGTON, November 27. —The spirit and morale of the logger, situated far within the vastness of our great Pacific forests, has been materially improved since the installation of modern radio receiving sets in logging camps. Many of the western newspaper broadcasts carry the daily news of the world into the heart of our lumbering districts, where their daily papers do not reach and the telephone is not available.

Instead of waiting a month to learn of some event in the outside world, the logger gets press dispatches daily. Thanks to radio he is no longer a "back-woodsman" in the old sense of the word. He got a good item on the President's message on the Ship Subsidy and the final score of the Army and Navy game almost as soon as the city radio fan did.

"With modern apparatus of the vacuum tube type, the logger can tune in on no less than forty broadcasting stations from Calgary to Los Angeles and from Denver to Portland," according to the National Lumber Manufacturer's Association, whose research department has of late been devoting much attention to the use of radio. Up in the forest-clad hills of Oregon, far from the railroad and mail routes, a digest of the daily news or a concert from San Francisco, "listens pretty good," as one logger put it.

The logger's radio set has a more important use than its recreational value, however; it is a business asset in the remaining big timber stands of the country. Through the aid of the fleet of air-planes, assigned to forest fire observation by Major General Patrick of the Army Air Service, each of which is equipped with sending and receiving radio, conflagrations in the districts patrolled have lessened notably.

Cooperating with Federal, State and private forest protection, high-flying airplanes cover more territory in a day than a forest ranger on foot could cover in three months. "Spotting" a fire, or smoke, the plane hovers over the site while the observer plots the location on a map and then broadcasts a fire warning giving the location. Station operators equipped with receiving apparatus catch the air scout's message and relay it, usually by private phone lines, to the ranger or patrol station nearest the fire, and within a few minutes detachment of skilled fire-fighters are enroute to the section in danger. Since speed is so essentia in fighting forest fires, first the airplane, and now the radio won the deep respect of the owners and operators of timber lands.

Radio also serves to anticipate the approach of lightning storms and to approximate their intensity, by means of a static barrage, which might be called a "radio lightning recorder." This consists, the Lumber Association states, of a movable loop antenna which rotates about a vertical shaft, not unlike a radio compass. By turning the loop parallel to the general direction of the oncoming storm the direction of approach can be determined witn an error of less than four degrees, as the static discharge is at its maximum when the loop is parallel to the line of approach.

The purpose of learning the direction of the storm is to enable the members of the patrol to plot its course and send out observers to locate trees struck by lightning. Lightning is said to cause 25 per cent of forest fires, and its particular hazard lies in the fact that unseen bolts strike trees and smoulder for days before actually breaking into flames.

The static barrage, the latest of radio fire-fighting equipment, has been operated quite successfully. Technically it measures the frequency of the static discharge and records it on a dial or indicates it visibly across a spark gap. When the frequency of the discharge becomes excessive an automatic electric gong is rung to announce impending danger. The direction of the storm is then determined by means of the radio loop and by the time the lightning is flashing over the stands of timber, patrols have started through the district threatened, alert to spot trees struck by bolts of lightning.

Many of the forest wireless stations are manned by ambitious young amateurs, some of them owning their sets, and all of them seeking to do constructive radio work and perfect their knowledge. One privately owned receiving set is reported to have picked up accurately messages from four airplane patrol routes scores of miles apart. It is easier to pick up different airplanes than it is to tune out an undesirable broadcasting station on a city set, because schedules and wave lengths are so well arranged in fire patrol work. that there is no interference, although several patrols may be flying at the same time.

City amateurs, who boast of thirty-foot aerial masts, would be envious of the natural masts available in the western forests, where giant fir trees tower two or three hundred feet aloft. At least they would be envious until they began to wonder how to utilize this excessive height for stringing an aerial. Upon the camp "high-climber" devolves the job of rigging the lofty antenna; he is skilled in climbing tall trees as part of the logging business demands daily trips aloft to oil pulley blocks for cables or in preparing a new setting for the yardage operation. By skillful manipulation of a single loose loop of rope around his waist and around the bole of the tree, the high climber, equipped with a pair of leg irons or spurs, slowly raises himself upward. With a deft twist of his wrist he flips the rope a foot or two upward at a time, trusting his weight to it while he replants his leg irons a ittle higher on the trunk. It is a task the city aerial erecter would not relish, and one requiring great skill and steady nerves, on the part of the climber, but that veteran thinks nothing of it.

Foresters and lumbermen say that in the Pacific Coast timber belt radio has accomplished within a few months what would otherwide have taken decades to bring about. It has become a permanent fixture tending to promote both contentment and efficiency as well as to afford a means of fire protection of hitherto undreamed of worth.

Harbord Succeeds Nally

Major General James G. Harbord, Deputy Chief of Staff of the Army, upon his retirement will become President of the Radio Corporation of America, Secretary of War Weeks announced Saturday. General Harbord was elected head of the Radio Corporation at a meeting in New York on Friday, and his release from the Army was requested on Saturday. His retirement will be effective on December 29, Secretary Weeks said, and he will assume his new duties on January 1, 1923.

Edward J. Nally, President of the Radio Corporation, it was announced, has been elected to a new office—that of Managing Director of International Relations, with headquarters in Paris.

Radio Direction and Range Finders Aid in Coast Defense

By CARL H. BUTMAN

(Copyright, 1922)

WASHINGTON, D. C.—The ranges of the shore defense guns of the United States will in all probability be extended twenty-five miles farther to sea by virtue of a newly developed radio range finder, now being tested on the Atlantic Coast. Previously, the maximum range of the great coastal guns was approximately 25 miles when visibility was good, but with the perfection of the signal corps radio devices, poor visibility is not a handicap and it is expected that a maximum range of about 50 miles can be reached provided the guns can be elevated high enough to shoot that far. Enemy ships will have to stand farther out at sea to be safe; at least, the fleets will be prevented from anchoring or disembarking troops within fifty miles of our shores in war time.

Three factors make up the essential principles of the new long-range fire control: Radio, aviation and plotting. For the first time in history, the post-war developed radio compass will be employed for a purpose other than to locate stations or give ships their bearings. The use of an airplane equipped with radio for spotting the fall of projectiles is not new but the unique feature today is the fact that the airplane itself will be out of sight, over the target or ship. Without awaiting the fall of sighting shots, the observer will send a series of radio signals which will make it possible on shore to plot the successive positions of the ship and determine its course and speed.

One of the problems of the Joint Coast Artillery and Air Service maneuvers, off the Virginia Capes, is a test of the new radio fire control devices and a comparison with the old method. Further trials will be held on Friday.

A boat visible from the shore will run various courses in an area several miles wide stretching seaward from Cape Charles and Cape Henry, the master of the vessel keeping an accurate time record of his course and speed. An airplane from Langley Field equipped with radio-sending apparatus will fly out, locate the ship and remain over it as much as possible by executing figure eights in the air. Flying at a height of several thousand feet, calculated to be safe from anti-aircraft fire, this observation plane will send special signals to the shore only when it is exactly over the vessel, continuing to do so until ordered in by the shore stations.

On the shore two radio compass stations several miles apart have been set up and direct lines of communication laid to the batteries. Operating just as when a ship's bearing is furnished, these two stations will pick up the signals sent by the observing plane when it is over the target ship, in other words, they will turn their compass coils until the radio signal is received with equal strength in both receivers, then the direction or angle from the stations will be read and plotted. With the angles at each station read simultaneously and the distance apart known accurately, it is a simple problem in trigonometry to locate the position of the ship and its distance from the battery. It is even simpler to plot the location of the ship on a map by laying down the angles from the two stations, extending the lines and noting their intersection. Within a few seconds a second signal comes in, and then another, all of which, when carefully plotted and timed, give the course of the moving target and its speed.

Firing may or may not be undertaken in the initial test, it does not matter, as that is solely a problem of ordnance and ballistics after the ship's course is plotted. The artillerymen do the rest, although they see nothing of their target many miles at sea. The most important feature of the scheme is its adaptability to night operations and in thick or foggy weather. Conditions do not matter as long as the observing plane can find the ship and fly over it. The distance from shore does not matter, but the range can be increased over the old range, limited by visibility from the observing towers, planes or balloons ashore, by many miles beyond the horizon.

A comparative test made by another plane flying nearer shore will also be made, but as the data this observer can give will be only in the form of estimates as to the bearing or azimuth of the vessel and its distance from Fort Munroe, it is not thought this old method can furnish the plotters with sufficient accurate information to compare with the more exact radio direction finding system.

Cooperating with the board of Coast Artillery and Air Service Officers conducting the test, Captain G. W. Morris of the Signal Corps is in charge of all radio operations during the first tests of the Army's new Radio Direction Finder now applied to gunfire.

Among other experiments to be conducted during the week will be tests to determine the extent of interference to radio telephone and telegraph messages caused by neighboring radio communications in operation.

Identifying Stations

(*By Washington Radio News Service.*)

Broadcasting stations are coming to be known by the voices of their announcers, their slogans and the stunts they do to identify their stations as well as the cryptic call letters assigned by the Department of Commerce.

There is little romance or euphony in the letters "W S B," but listeners-in are very familiar with the big gong which rings "bong, bong, bong," with the announcement of the entertainment and know it is the Atlanta Journal. The unmistakable southern drawl of the broadcaster there announcing that this is the "Voice of the South" is also an indication that W. S. B. is sending.

As the radio enthusiasts well know, there are a number of other stations using identifying phrases and sounds. For example, Courier Journal and Louisville Times WHAS, plays a few bars from the appropriate Southern melody, "My Old Kentucky Home." WDAJ, the Atlanta and West Point R. R. Co.'s Station, at College Park, Georgia, has conceived the unique method of establishing its identity and business by blowing four blasts on a locomotive whistle; when "toot-toot-toot-toot" resounds in your receivers, it is sure to be WDAJ broadcasting. The Naval Station at Anacostia, NOF, is known by the deep bass voice of the announcer.

It is not only in the Southland that these slogans and phrases have become popular; farther west we have the Palmer School of Chiro-

practic at Davenport, Iowa. "This is WOC," the announcer states, "Out Where the West Begins." Another station identifies itself with: "Out where the corn grows tall." The voice of the spokesman at WOH, the Hatfield Electric Co., at Indianapolis, might confuse one at first, it sounds so southern and is similar to that of WSB in Atlanta. Who says "Ayand"? The pronunciation of the simple word "and" would hardly locate a station, but ask anyone who has heard "Mr." KDKA at Pittsburgh, and see if they will not admit that the drawled "ayand" is a positive identification?

The voices of the evening story tellers are all well known by the small radioites. Some of the broadcasters sound a signal on the telegraph key giving their call or some single letter indicative of their station besides the customary transmission of the letters by an announcer.

Methods of announcing the time also serve to establish who is at the transmitter, and those who hear the Louisville Courier Journal say they like the method of telling the time as the hour approaches, with a simple statement of ten o'clock when the minute hand reaches twelve better than the standard tick system of the Naval Broadcasting stations.

When the Detroit News signs off, the exact time is given, which is a benefit to those who have not set their timepieces for the night.

Probably the custom will grow rapidly and familiarity with the voices of broadcasters all over the country as well as the mottoes and slogans of stations will extend the acquaintance of listeners-in with the voices of the air.

An Excellent Detector

Radio Age Institute has received from the Clifton Manufacturing Company, Newark, New Jersey, one of the new detectors being manufactured by that company. The detector performs excellently and one Chicagoan who is using a Clifton detector reports that "It is the neatest and most compact little thing I have yet seen and adds 100% to the efficiency of the set."

Safety Talks via Radio

In connection with the activities of National "Safety Week," NOF, at Anacostia, carried a series of safety talks by radio each evening. Colonel C. O. Sherrill, Superintendent of Buildings and Grounds at the Capital, arranged with the Naval Communications Service for speakers to broadcast short talks on safety, commencing Monday, November 27.

The Aerial Press of America

By Washington Radio News Service

PERHAPS at last there is something new under the sun. Who ever thought of an aerial newspaper before a few pioneer mentors of public opinion began broadcasting their news items that all who "listened" might hear—free?

Among 582 radio stations broadcasting in the United States today, there are 83 representing publications, most of them daily newspapers. Nine of these etherial news sheets are super, or Class B, stations especially licensed to broadcast on a 400-meter wave. All told, these news broadcasts of the air reach millions who do not subscribe to the publications but who are most enthusiastic aerial "hearers," none the less loyal to their favorite papers because they are unknown to the editors. There is an "Aerial Press of America" even though there are no aerial subscription lists and no advertising accounts.

It is certainly something new, this broadcasting of the news and sports of the world gratis; it is a service highly valued by the hearers and many predict that it has come to stay. Some Canadian newspapers have also taken up the scheme of news broadcasting, as well as publications in Porto Rico and Hawaii.

Radio can be used in the gathering of news as well as in its dissemination, especially in country districts, and tends to broaden the scope and circulation of a newspaper. There are several known instances where radio carried daily news reports when other lines of communication failed, and in some instances amateurs aided. An "SOS" story on land has been covered by wireless and aid rendered by means of radio. as well as at sea, and instances where the wires and regular channels were beaten are recorded.

Government weather, crop and market reports are now carried via radio in advance of press releases, and the only way a paper can hope to compete is through the same medium.

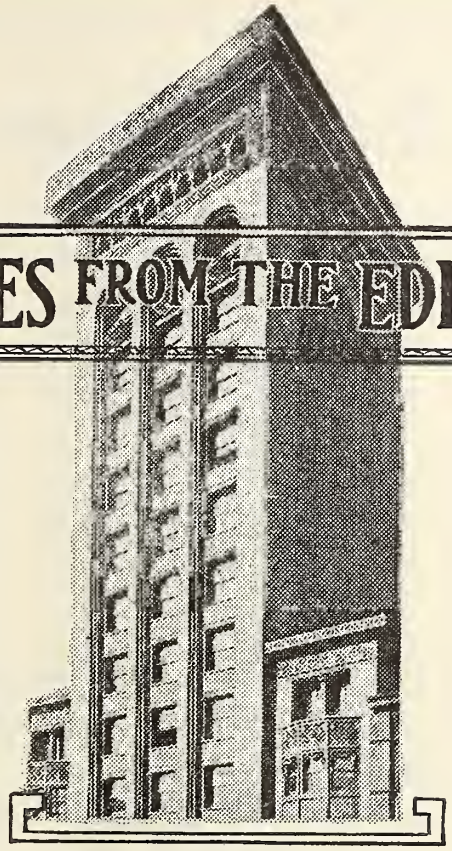
"Why give away material?" may be asked, and this is well answered by citing the case of the Boston American's experiments in broadcasting bulletins from its news before they were printed. The news is transmitted from WGI, Medford Hillside, and the service to thousands is reported to have brought most valuable publicity to the Boston sheet. Those who listen into brief news items all want to know more of the details and naturally purchase a copy of the "Mother" sheet as soon as it is available. Out of over 80 papers licensed to broadcast, only about half a dozen have stopped this service and some of those have combined with other organizations in the use of a single broadcasting station.

Press broadcasting stations should handle all news, some students of the problem believe, looking to the future, since the news is really owned by the members of the press and is received first by them; besides which, the publishers know how to handle the news better than any other agency. Newspapers, usually in the lead of progressive developments, are apt to find it necessary to follow the lead of the aerial pioneers and carry radio news bulletins for their clients in the future. Radio as a household contact with the world has come to stay. On the farm especially this is so, and unpaying aerial subscribers would be very loth to lose their news service.

Of the newspaper broadcasters, nine have secured the Class B License permitting them to broadcast on 400 meter wave; they follow: Atlanta Journal, Atlanta Constitution, Dallas News, Detroit News, Detroit Free Press, St. Louis Post Dispatch, Kansas City Star, Fort Worth Star Telegram and Los Angeles Times-Mirror.

The Seattle Post Intelligencer now uses the broadcasting station KFC; the Philadelphia Record broadcasts through WCAU; Ensenada News at Yauco, Porto Rico, uses WGAD; The Indianapolis Star's news is released through WOH; The Tacoma Times cooperates with KMO; the Oklahoman "speaks" its news over station WKY; the Boston American uses WGI, and the Memphis News-Scimitar announces over WPO. In canada, two news broadcasters are the Toronto Daily Star, operating CFCA, and The Winnipeg Tribune CJNC.

Among other daily sheets said to be planning to use news broadcasting are the Courier of Grant's Pass, Oregon; Midland Mail, S. D.; Billings Mont., Gazette; Raleigh Register, Beckley, W. Va.; Adrian Daily Telegram, Mich.; Litchfield News Herald, Ill.; and the San Pedro Pilot, California.



THOUGHT WAVES FROM THE EDITORIAL TOWER

LEAST observant of radio enthusiasts will have discovered an interesting new tendency on the part of users of radio receiving sets. Everywhere it is apparent that fans are most keenly absorbed in getting long distance calls. They will tune out a delightful concert near by in order to hear a station anywhere from 500 up to 2,000 miles away. Many fans are happiest when they are striving for a record in hearing the greatest possible number of stations in a single night.

The trade will not overlook the situation. With this rivalry for premier excellence in getting long distance broadcasting and in covering as much of the country as possible in a single sitting there is bound to be a growing demand for superior receiving sets. The amplification question will be one of the first considered. The selectivity of the apparatus will be another cardinal point to look for.

WE have heard a deal about the activities of the National Radio Chamber of Commerce. It is an organization which has announced its interest in all phases of the radio art and the radio business. Perhaps the Chamber of Commerce will soon issue some needed information as to the demand and supply situation. We suggest that a survey giving all the radio interests a comprehensive glimpse of the radio business and what is holding back that long-deferred revival would be of value. Come on, National chamber, if you have something of interest for the whole crowd we'll print it.

A. H. GREBE & CO. have been sued by the Radio Corporation of America for alleged violation of patent right in connection with the use of vacuum tubes. Counsel for the Grebe company contend that if the claim of the Radio Corporation is sustained it will tend to establish a basis upon which a monopoly could be reared. The defense points out that all radio instruments must be used in connection with the vacuum tube.

We have never met Mr. Grebe although we are perfectly familiar with the Chinese who always adorns the Grebe advertisements. That Chink is becoming as well-known in radio as is the gentleman of color who decorates the Cream of Wheat ads. If the Grebe Company would like to reach an important middle-west circulation with detailed information about this suit Radio Age would be pleased to publish it.

There is considerable litigation in progress in connection with the radio patents and the radio business. Any piece of news that suggests that an effort is being made to monopolize radio patents and manufacturing and operation is the biggest possible piece of news for hundreds of thousands of Americans. We know nothing of the merits of this suit but all facts of record pertaining to litigation in this free country are privileged matter for publication. And there is nothing in the policy of Radio Age to interfere in the slightest degree with our publishing all the facts on both sides of any matter. We are going to get what we can for the January number. Let us switch on the light and quit trying to size up the radio game by reading obscure items in corners of newspaper pages.

THE Associated Press is warning newspapers that they must not broadcast local news, if they are members of the Associated Press. That means that the newspaper which holds an Associated Press franchise—and most of the large daily papers hold such a franchise—that newspaper shall not broadcast or give to broadcasters news about a big fire, an election result, or any other information that the Associated Press might want to send out over its own wires as news.

Looks as if the broadcasting of news was going to get a setback. If radio is a craze or a toy, what in demnition is all the shootin' for?

BROADCASTING of "La Boheme," grand opera, was advertised for the evening of Wednesday, November 15, from the Westinghouse Station KYW, Chicago. At 8:30 that evening, when the opera was about to start, the station announcer gave the information that there would be no opera program for that evening. He made no explanation by radio but it was later learned that the reason for the sudden change of program lay in the fact that the American representatives of the owners of the "La Boheme" copyright had forbidden KYW to broadcast the music. These gentlemen maintained that such broadcasting would be an infringement of copyright.

The incident is important in that it seems to have set an informal precedent in a question which has been in dispute for some time. It raises the question in the minds of the broadcaster as to whether the owner of any piece of copyrighted music may not at any time set up a similar contention. Will owners of copyrighted songs be able to make the same restriction? Will the author of the "bed time story" arise to demand his fee?

The National Broadcasters' League is obtaining a legal opinion as to the rights of broadcasters to transmit copyrighted music, songs and printed material. For further information members of the League should address Frederick Smith, Secretary, Garrick Building, Chicago.

The Voluntary Lid

AS A result of experience through the past year of broadcasting, we have a definite program to recommend for amateur consideration. There have been many unjustified complaints against amateur QRM and of course where amateurs in cities have hogged the air all evening there have been justifiable complaints. Most of us have realized that broadcasting was capable of becoming a powerful force for good in our country, of tremendous social, economic and educational value, and have known that meant the passing of the old days when we could pound brass from supper-time on and the ushering in of a new era when the air had to be shared. As we have pointed out previously, many of us have gone so far in the business of sharing that we have almost been afraid to operate at any time, and amateur radio has suffered for the lack of a definite plan. On the other hand there are uninformed novice listeners who object to amateur transmission at any hour of night, and again the need for a recognized scheme has been shown. This we now offer.

Broadcasting is admittedly an institution of the early evening hours. That is the time that quiet air should prevail, when the greatest good can be done for the greatest number. When should we open up our stations for transmission? Our Board has considered that question and has decided upon 10:30 p. m. as the proper time. We're regretfully obliged to conclude, fellows, that the time is here when we should voluntarily keep our transmitters silent during the early evening hours if their operation interferes with listening. This means that in all congested communities amateur stations should be quiet between the hours of 7 p. m. and 10:30 p. m. This is no new thing for most of us—we've been doing it already—but it makes it a recognized principle of amateur work.

We urge our members and clubs to get together with the listening-in element in their community and have an understanding on the subject. Acceptance of this plan on the part of the amateurs means that they recognize the rights of the listeners to hear their concerts undisturbed, and that they will keep quiet between these hours. Acceptance of this plan by the novice listeners means that they recognize the rights of us amateurs to transmit and carry on our useful work and that they will not complain against the "meaningless buzzes" when the lid goes off at 10:30. This plan was proposed at a meeting of all radio people in Rochester recently and was adopted as a solution of the local difficulty. We may well call it "the Rochester Plan."

Whenever a community gets together and agrees upon such a plan, we feel that it should become as law and that the mere possession of a transmitting license should not entitle an amateur to go contrary to the sentiment of all his fellows. It is our view that such operation, unless justified by an emergency or official tests, would constitute deliberate and malicious interference within the meaning of the federal radio law, and we believe the Department of Commerce will agree with us. On the other hand, in localities where this plan is adopted and quiet air is maintained between 7 and 10:30 p. m., we will expect amateur transmission to proceed without complaint after 10:30, and the A. R. R. L. will protect with every resource at its command the right of any of its members to so transmit if unjustly accused while legally operating in such a community.

IT ISN'T such a bad world after all! The American Radio Relay League, comprised of amateurs who transmit those dots and dashes which have been punctuating some of our most pleasing broadcast programs have taken official action to help diminish interference. Radio Age is a magazine for the novice, but we are glad to republish the accompanying editorial from Q S T, a magazine for the amateur, in compliance with a request from the American Radio Relay League.

Now we have a working plan. Let us adopt it, fellow amateurs. This puts an important duty of self-policing on the shoulders of our affiliated clubs and we are depending upon them to handle the job. When this plan is adopted it must be respected, religiously, and this means that unlicensed and improperly adjusted stations must be hunted down and turned in. In bygone days such a station bothered no-one but its neighborhood amateurs, and if they could put up with it there was no harm done; but to-day such a station will bring discredit upon all of amateur radio and must not be permitted to exist. We would suggest that clubs establish committees to help local amateurs and render assistance when needed to get a station properly adjusted, but if the operator persists in operating illegally after being warned he should be turned in to the inspector without mercy—we have too much at stake. Other folks are watching us too, and while we think about it we want to tip off everybody to get their station and operator licenses renewed promptly upon expiration.

What about local work, which used to occur in the early hours of the evening? Honestly, we don't know, and it will be up to the amateurs of each club to decide for themselves how they will divide their hours. The time after 10:30 is going to be very precious and, solely because it is not as important as DX work, we are afraid local work will have to be got over with by the time 7 o'clock rolls around. Low-powered battery-operated C.W. sets of course can be used for local work all evening long and not cause a particle of QRM for the broadcasting fan next door, but most of the lads who do local work have a far different kind of equipment—hi!

Our transmitters must improve. There will be too many of us with traffic to move at 10:30 and too many listeners with dumbbell tuners for us to continue much longer with the cycle-consuming spark of prewar days. For the very efficiency of our traffic moving the selfish spark will have to yield to the valve set. We hasten to say, though, that there are selfish C.W. sets too, and we are just as much against a bum C.W. without rectifiers and filters as we are against the ordinary spark, and for exactly the same reason—it takes up too big a place in the air, its wave is too broad. We cannot be pushed into an adoption of C.W. versus spark against our will, but left to our own devices we believe it is evident to any thinking amateur that the quiet efficiency of the little bottles is just the thing we need—filtered D.C. C.W. transmitters.

Now let's get busy on our self-imposed 10:30 lid. Remember that the League does not feel that it can back a member who runs loco in a congested locality and smears a whole county with QRM from the minute his supper is down, but that it will safeguard the interests of its law-abiding members in communities where the Rochester Plan is adopted and *respected*.

One thing more. Noise this about a bit. Let it be known that we amateurs have decided among ourselves to preserve some quiet hours, out of consideration for the broadcast listeners. Spread a little honest propaganda in your local newspapers.

K. B. W.

The Monthly Service Bulletin of the

NATIONAL BROADCASTERS' LEAGUE

Solely by, of and for Radio Broadcasting Station Owners

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Western Radio Corporation
Denver, Col.
President

Arthur E. Ford, E. E.
State University of Iowa
First Vice President

W. J. Baldwin, W S Y
Alabama Power Co.
Birmingham, Ala.
Second Vice President

Frederick A. Smith
Garrick Building,
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Secretary

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Executive Offices, Garrick Building, Chicago, Ill.

DIRECTORS:

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Indianapolis, Ind.

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Radio Engineer,
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The New Haven Electric Co.
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Howard E. Campbell, W W J
The Detroit News,
Detroit, Mich.

A. J. Westland, W W L
Physics Dept. Loyola University
New Orleans, La.

J. Elliott Jenkins, W D A P
Midwest Radio Central, Inc.
Drake Hotel, Chicago, Ill.

H. A. Trask, K S D
St. Louis Post Dispatch
St. Louis, Mo.

Frank W. Elliott, W O C
Palmer School of Chiropractic
Davenport, Ia.

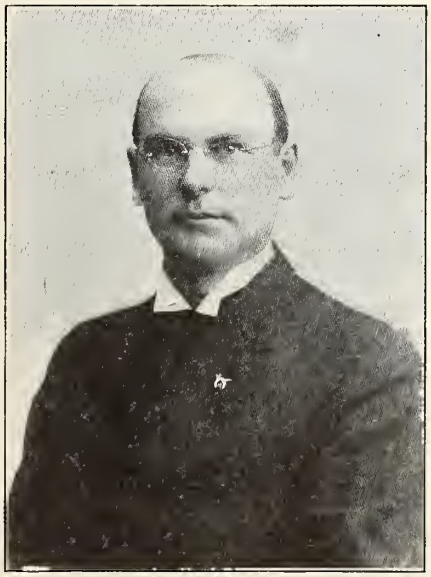
THE organization of the National Broadcasters' League has been completed and the correspondence from members to the Secretary's office already has become voluminous.

One of the first tasks of the Secretary was to provide to many broadcasters copies of the Kellogg-White bill, about which there was considerable discussion at the initial meeting of the League in the Sherman Hotel, Chicago. Several broadcasters have expressed the determination to broadcast the gist of the bill and ask the listeners-in to support pressure on senators and congressmen to see that this legislation is attended to without further unnecessary delay.

It will be remembered that T. W. Findley, President and general manager of the Findley Electric Company, Minneapolis, Minn., and operator of the station WLAG of that city, suggested the broadcasting of the contents of the Kellogg-White bill in his speech to the broadcasters at the first meeting of the League.

Some owners of stations are opposed to the bill in some of its aspects but even these are agreed that the proposed regulations are better than none. All broadcasters have indicated a desire to see Congress put through some corrective legislation.

There have been numerous inquiries also as to the reason for the abandonment of the plan to broadcast the grand opera "La Boheme" from the Westinghouse Station KYW, Chicago, recently. It appears that owners of the music rights had warned the operators of the powerful Chicago station, which first put grand opera music in the air (thereby booming the radio business) that they would consider it an infringement of the copyright if "La Boheme" were broadcast. Without making any issue of the matter KYW, at 8:30 o'clock on the night the opera was to have been broadcast, issued notice via the ether, that he program had been changed.



President George S. Walker, live-wire Chief of the Broadcasters League and President of the Western Radio Corporation, Denver, Col. His station is K F A F

The blow to radio activities would be considerable if opera were to be removed from the winter entertainment of receiving set owners. It may be said, however, that other operas are not tied up by copyrights and that KYW will broadcast opera two nights each week.

Announcement of the election of directors in the League were sent out by mail to those who were unable to attend the Chicago meeting. Favorable replies were received from all of the station owners elected and all expressed deep interest in the League and readiness to give their time and effort to making it effective.

S. W. Place, of the Diamond State Fibre Company, is the Pennsylvania director. A. J. Westland, Loyola University, New Orleans, La., is hopeful that the League will be of great benefit to the broadcasting art but fears his multiplicity of tasks in connection with his university work may make it impossible for him to serve the league with the diligence that he would like to devote to it. The Secretary is writing to Professor Westland that the busy men are the ones the League wants in its directory, as they are the men who are getting somewhere in radio.

W. J. Baldwin, Second Vice President of the League, of the Alabama Power Co., writes: "I believe we have taken a great step forward in the development of radiophone broadcasting."

Howard E. Campbell, Chief Radio Engineer of the Detroit News Station WWJ is an interested correspondent. To Mr. Campbell, and to all others it may be said here that further data and news of developments will be going through the mails soon.

Arthur H. Ford, State University of Iowa, First Vice President of the League, writes that the formation of the League seems to have come at the right time and adds three cheers for the Iowa football team.

Earle C. Anthony informs us that his station is a new 500 Watt Western Electric plant, which receives its information from four studios by telephone wires and then broadcasts it. Mr. Anthony asks that all correspondence relating to the League be forwarded to him under the address "Earle C. Anthony, Inc., Los Angeles." The Anthony station is KFI and it is a good station, as all know, who have "listened in."

Stanley O. Need, the director in Connecticut, represents the New Haven Electric Company, writes that he is a long way off from League headquarters but that his spirit is with us and that he is "only too glad to do anything to assist the League."

T. B. Hatfield, President of the Hatfield Electric Company, Indianapolis

which operates Station WOH, says, "I sincerely trust you have made a start which will be of benefit to all broadcasters."

J. Elliott Jenkins, one of the two owners of the now famous WDAP on the roof of the Drake Hotel, Chicago, is another director. His associate in the Midwest Radio Central, Inc., which operates WDAP, is Mr. Thorne Donnelley. Messrs. Jenkins and Donnelley have adopted many original methods in arranging programs and in announcing the programs. Furthermore, they are making some important long distance records and are adding to their equipment to make their station even more effective.

With such men behind the League it is bound to carry weight whenever it steps out to get something done.

George S. Walker, President of the Western Radio Corporation of Denver, Colorado, proprietor of Station KFAF, and President of the National Broadcasters' League, has been doing some effective missionary work for the League.

Mr. Walker returned to Denver a few days ago from an extended trip through the East, where he conferred with broadcasting station owners, manufacturers of radio apparatus and others, and when interviewed at his office by the Denver Post, said:

"As was to be expected, I found radio in somewhat of a slump as the result of the long Summer season, but with signs of a revival with the return of cold weather. Manufacturers of receiving sets, apparatus and supplies were, for the most part, a little discouraged and somewhat apprehensive as to the future. However, it was the consensus that radio has come to stay and that at no distant date the new science will be highly commercialized and will play just as important a part in the affairs of the world and in every-day life as the telephone and telegraph.

"I found that, while as late as May 15 of this year, manufacturers were away behind in their orders for sets, tubes and practically everything entertering into the manufacture and operation of receiving sets, quite the reverse is now the apparent situation. Manufacturers, distributors and dealers, in all parts of the country at the present time, carry sufficient stocks of goods to meet almost any demands, except, of course, in the event that this demand should far exceed that of last year, and even then, the facilities of the manufacturers are such that there should be no real shortage in high class radio equipment, and as for the cheaper apparatus, this already is becoming a drug on the market; for the radio buying public has become a discriminating body

"That the broadcasting and reception of radio entertainments will steadily improve with the installation of better apparatus, goes without saying. Indeed, important improvements are noted almost daily, and will continue at almost the same speed that has established radio as one of the industrial wonders of the age.

"While much has been written and said with reference to broadcasting, and the broadcaster comes in for a lot of criticism, it can be truly said that the science of broadcasting is far in advance of the art of receiving, and this is not strange when the facts are carefully considered. The broadcasting apparatus has been developed to a hign stage of efficiency by the government, by the large companies and also by a few individuals giving freely of their time and money in the work. These broadcasting stations, for the most part, are operated by experts in their line—radio engineers who have spent years in the service. On the other hand, reception of entertainments broadcast by the many stations in the United States, Porto Rico, Alaska and Hawaii is in the hands of countless thousands of fans operating apparatus from the lowly crystal set costing a few dollars to the highly developed instrument costing hundreds, and even thousands of dollars. These receiving fans have been, and still are being educated in the school of experience, whereas the broadcaster gained his knowledge of radio as a result of years of technical study and work.

"It is not strange, then, that there exists in the minds of the fan a feeling of dissatisfaction over present conditions. His constant complaint is of interference, but with increased knowledge and the use of improved apparatus will come to the fan a better understanding of radio and a feeling of grateful satisfaction, for outside of the initial cost and a small maintenance expense, his radio entertainment costs him absolutely nothing.

"There are two big questions in radio today. One is interference, which will be solved when the government stops issuing broadcasting licenses and applies different wave bands to the large number of stations now operating, and by a more detailed knowledge by the fans of how to operate receiving sets. The second problem is how will the broadcasting station obtain proper support for their expensive efforts to provide this wonderful radio entertainment to more than one hundred and ten millions of people. Many plans have been suggested, but none apparently is workable. That some plan eventually must be found, goes without saying, for the broadcaster cannot be expected to indefinitely provide entertainment without cost to the largest listening audience ever assembled in the history of the world.

"It is for the purpose of solving this and other problems, to improve broadcasting, and also to educate the fans as to how to obtain satisfactory results from their receiving sets, to obtain broader and better laws governing radio, etc., that the National Broadcasters' League was organized. There are at the present time 531 broadcasting stations enrolled in the United States. Of this number 183 are located in the Eastern states, 209 in the Central and Southern states, 106 in the West Coast states, twenty-eight in the Rocky Mountain states, one in Alaska, two in Porto Rico and two in Hawaii. The investment in these stations will aggregate more than $5,000,000."

OWNERS of broadcasting station owners who have not yet joined the National Broadcasters' League, may do so by sending their check for the annual membership fee of $10 to Frederick Smith, Secretary, Garrick Building, Chicago.

Membership will entitle broadcasters to periodical information as to developments in connection with broadcasting, intelligence as to steps taken to eliminate the present almost disastrous interference and news of events in any part of the country affecting broadcasting and broadcasting interests. Also members will receive the official organ of the League for one year.

This nominal fee is required for the cost of issuing circulars and handling the large volume of correspondence. You will find it useful to be associated directly with this clearing house for broadcasting information, which is also a protective institution, offensive and defensive.

Pay for Stations

The following letter is written by Mr. Duryea Bensel, Secretary and Treasurer of the Bel-Canto Corporation, 417 East Thirty-fourth Street, New York City:

"Broadcasting has been under discussion for some time and much has been said pro and con, but I have something to say which I think is of paramount importance.

"The Radio Corporation of America were the pioneers of Broadcasting Radio concerts and have not only kept up the fine quality of these concerts but have improved upon them from time to time, giving the Radio fans the best quality of talent procurable. Without this broadcasting there would, practically, be no market for radio parts and it is my opinion that each and every manufacturer of Radio parts, whether it be a loud speaker, a complete set, a hundred feet of antenna wire or any of the other numerous parts that go into the making of a complete set, should be willing to contribute a certain portion of their net profits towards the maintenance of such a station. Each and every manufacturer of radio parts is indebted to the broadcasting stations; without them, the manufacturer might just as well put the key in the door and hang up a sign TO LET. Why should a corporation, such as the Radio Corporation of America, who are spending millions of dollars to make radio a permanent sound and healthy institution which in time is destined to become one of the greatest industries of the world, or, in fact, any other organizations who are maintaining broadcasting stations throughout the United States, have to bear the entire expense of maintaining these stations?

Pick-Up Records by Our Readers

Reinartz Makes Good

Mr. F. D. Pearne,

Dear Sir:

Just having read Mr. Bisnah's "pick-up" record in the November issue of the "Radio Age," I thought I would let you know of the results I am having.

I completed my Reinartz set in the latter part of September and since that time I have picked up WJAQ, Topeka, Ka.; WBL, Anthony, Ka.; WAAP, Wichita, Ka.; DN4, KFAF, Denver, Colo.; WSB, Atlanta, Ga.; WHAS, Louisville, Ky.; WLK, Indianapolis, Ind.; WFAA, WDAO, Dallas, Texas; WBAP, WPA, Ft. Worth, Texas; WEAY, San Antonio, Texas; WOH, Indianapolis, Ind.; WCAL, Northfield, Minn.; WBAD, Minneapolis, Minn.; WFAT, Sioux Falls, South Dakota; CJCG, CJNC, Winnipeg, Manitoba; KSD, St. Louis, Mo.; WDS, Jefferson City, Mo.; WMAB, Oklahoma City, Okla.; WAAZ, Emporia, Kas.; WLAD, Hastings, Neb.; KZN, Salt Lake City, Utah; KHJ, Los Angeles, Calif.; KGG, Portland, Oregon; KYW, WDAP, Chicago, Ill.; WOC, Davenport, Iowa; WLW, Cincinnati, Ohio; WFO, Dayton, Ohio; KDKA, Pittsburgh, Pa.; WWJ, WCX, Detroit, Mich.; KWX, Havana, Cuba; WFAG, Waterford, N. Y.; WGY, Schenectady, N. Y.

I used two stages audio-frequency amplification with a dictagraph loud-speaker; 95 per cent of these stations could be heard and understood fifteen feet from the loud speaker.

My aerial is a single wire thirty feet high and one hundred feet long.

I have constructed several types of sets but I find the Reinartz tuner more efficient, more sensitive and easier to adjust on DX work than any set I have ever seen. I wish to thank you for the instructions you gave in the Radio Age. I heartily recommend this set to any amateur who is thinking of building a set. I think this is a pretty good record for a little over one month.

Very truly yours,
K. P. ANDERSON,
3032 Michigan Ave.

From New Mexico

L. P. Evans, Artesia, N. M., on the border of Old Mexico, writes that he heard the Robin Hood selections broadcasted by KYW, Chicago. W. N. Jacobson, San Francisco, reports that he was tuning in for Davenport when he got Chicago. Then a local San Francisco station took the air and that was the end of KYW.

Wireless in Mexico

The Mexican Government is about to receive four powerful wireless telegraph sets, which are to be presented to the Republics of Guatemala, Honduras, Costa Rica, and Nicaragua, in accordance with the decision of the President of the Republic.

Michigan Gets Honolulu

Editor Radio Age:

I note on page 22 of your present issue that you have an article headed long distance records. It might interest you to know that Mr. Kenyon Voght, of the Mead Drug Co., Escanaba, Mich., has with his set (Zenith) and two stages of amplification distinctly heard Honolulu on two different occasions.

This I think is a distance record for radio telephony.

Voght will be very glad to verify this.

Cordially yours,
E. F. McDONALD, JR.,
Chicago Radio Laboratory.

Local Silent Periods

By CARL H. BUTMAN

The radio public is beginning to demand not only good entertainment, high class transmission but a greater range of reception. In other words, the listener-in wants to reach farther afield, his horizon is extending, he wants to hear the distant stations outside his city and state, and the Department of Commerce radio officials are making a survey of each radio district to see if there isn't some way that this can be arranged.

One radio enthusiast has put it well; he says that, while he is appreciative of all his local stations, he sometimes wants "to go visiting by radio"—listen to some of the big stations outside the local field, just as he frequently likes to listen to the conversation of others than his immediate family, which he cannot do if those at home talk all the time. It's the same in radio broadcasting he says.

In an effort to aid in seeking a solution of this new problem, the Department of Commerce has written letters to its nine radio district inspectors advising that information reaching the Department indicates that there is developing a sentiment throughout the country for silent local radio broadcasting periods so that the listeners-in can hear the distant stations which is often impossible when local stations are broadcasting. In some sections of the country steps for such an arrangement have already been taken. On the Pacific Coast, for example, what is known as the Pacific Plan of time division recently has been amended so that from 8 to 10 each evening the amateurs are silent, permitting the broadcasters to have a clear field, and at ten the amateurs have a period during which they can communicate without interruption.

In other sections the local broadcasters remain silent for one evening a week or a few hours one or two evenings a week so that those having receiving sets capable of long distance reception can pick up some of the powerful broadcasters outside their district. The Department points out that there is a great fascination to listening to distant stations and it is the opinion of the Radio Section that this desire on the part of the radio public will meet with the cooperation of most of the broadcasting stations, when it is understood. Broadcasters and local enthusiasts will do well to advise local inspectors what they think of the plan or take it up with the Department directly.

It may be found desirable to divide the United States into zones somewhat as it is divided into time zones, the stations in a particular zone having silent nights or periods of two hours each. It might be arranged so that the broadcasters in the Eastern Time Zone would not transmit on Monday night, those in the Central Zone keeping quiet on Tuesday, Mountain section Wednesday and the Pacific Coast on Thursday, all sending on the other nights. The Department Inspectors have been requested to bring this suggestion to the attention of owners of broadcasting stations in their districts and explain it to broadcasting and listening-in organizations. Reports from the Inspectors will indicate the desire on the part of the public and the attitude of the broadcasters, who will have to arrange the matter as the Department's plan is only a suggestion.

Radio fans who complain of interference must not forget, officials point out, that the execution of such a plan will not enable them to get long-distance stations unless they have good sets and know how to tune them in properly. The scheme is expected to receive the indorsement of the public and broadcasters alike but it can only be successfully carried out with close cooperation of everyone, and the reports of the Inspectors is awaited with interest in Washington.

Gets Miami Naval Station

The lease of the Naval Radio Station at Miami Beach, Florida, was awarded to the Tropical Radio Company of Boston, Mass., the highest bidder in the recent call for bids. This company, which is connected with the United Fruit Company, offered to take the station for 18 months at an annual rental of $3,600, with permission to extend the lease an additional year. The Radio Corporation of America, and Cutting & Washington of New York, also filed bids.

According to the terms of the lease, the Tropical Radio Company must replace the old rotary spark set with modern equipment which will reduce the objectional noise to a minimum.

With the enactment of necessary legislation, it is understood that the Navy will ultimately offer the station for sale.

Send $1.00 to Radio Age, 64 Randolph Street, Chicago, and receive this middle-west radio periodical for six months. Regular subscription price is $2.50 a year. Thus you will be getting one month free.

With the Radio Trade

Who's Buying Goods?

This magazine has received numerous inquiries as to the proper lines to follow in sales campaigns and has been able to give the trade some useful information obtained from its readers and advertisers. The following letter embodies an analysis that cannot fail to be of interest to the trade generally:

Dear Mr. Smith:

In reply to your letter of the 17th inst., I would say that on September 15 I started a national advertising campaign of selling our Sensitone regenerative sets by mail on the time payment plan, using the following mediums: Farm and home papers, fraternal, technical, trade and boys' home magazines. My main idea was to reach the farmer, as he was the one that should naturally take the greatest interest, i. e., getting market reports, etc. The results may be interesting to you. Out of the hundreds of sets that we have shipped, not one as far as we can trace, has been ordered by a farmer, in spite of the fact that we spent 40 per cent of our advertising appropriation in farm journals. 70 per cent of orders came from towns of 50,000 and over, and the balance from the small towns, mainly those with a population of from 1,000 to 5,000. As to States, the following produced the best results in the order named: Iowa, Texas, Oklahoma, Missouri, Illinois, Georgia, Wisconsin, Florida, California.

Trade papers like yours pulled well from a very intelligent class of customers. All the foregoing leaves an unanswered question in my mind, "Why doesn't the farmer fall for radio like he does for victrolas, piano players, etc."

Yours faithfully,
HAROLD R. WAKEM & CO.,
Harold R. Wakem, President.

New Battery Charger

A new type radio and automobile battery charger for convenient home use has been announced by the Valley Electric Company, 3157 South Kingshighway Boulevard, St. Louis, Mo.

The new model has been designed so that it is suitable for installation and use in any room in the home. Similar in appearance to the watthourmeter, it is enclosed in a moulded glass cover which shows all working parts. The material used in the contacts will not stick. No bulbs are used.

The Valley Type A and B Charger will charge a 6-volt A radio battery or any make automobile battery at a 5-ampere rate without the use of lamps or complicated connections. It will also charge 22½-volt and higher voltage B radio batteries.

This new model charger plugs in on the home lamp socket just like the ordinary electric light bulb. It connects to the battery by means of clamps which are furnished with the instrument. It produces a quick tapering charge at a trifling cost. It cannot harm or overcharge a battery.

Radio Desk Set

One of the most interesting radio devices thus far submitted to Radio Age Institute is a business man's radio desk set designed along the lines of a telephone. Crystal detector, head set are combined complete in an instrument closely resembling the ordinary telephone transmitter with the exception, of course, that there is no telephone receiver attached.

The aerial that goes with this outfit is only forty feet long and is easily laid around the moulding near the ceiling or may be strung around the baseboard near the floor. All that is necessary to get a ground is to attach the clamp on end of the aerial to a radiator or water pipe.

The entire outfit can be set up in two minutes. It is capable of getting broadcasting stations within the same radius in which any other good crystal set operates.

It is a fool-proof device requiring no adjustment or outside aerial. Traveling men can easily put it into their hand bag and use it in their hotel room and get the concerts or market reports in any city they may be visiting. The busy man at his desk who is interested in the stock market or the grain reports can get them at the scheduled broadcasting periods by simply picking up the receiver and putting it to his ear. The outfit sells for $20.00 complete. It was invented and is being promoted by G. D. Norton, 1705 Garrick Building, Chicago.

An Improved Rheostat

The Wilcox Laboratories, of Lansing, Mich., are placing on the market a new rheostat about which they give the following information:

Our first aim in producing this rheostat has been to present a design incorporating every improvement possible in rheostat construction.

Our second aim has been to produce a rheostat so finely made and perfectly finished that it will add to the efficiency and appearance of the best equipment.

Our third aim is to sell this high quality product at the lowest price our quantity production will permit.

The resistance unit is formed of the best grade wire tightly wound on a strong fibre support and is not apt to become loose or lose its shape through overheating or rough handling. It is 100% ventilated, every inch of the wire being exposed to the air. The carrying capacity is 1¼ amperes and the resistance full six ohms.

The movement is exactly 180°, this being the most convenient for the operator and in addition permits the knob and pointer to be replaced easily and quickly by any 180° radio dial if desired.

The ¼-inch round shaft turns in a carefully fitted brass bushing which insures a longlived free running bearing, regardless of the accuracy of the hole in panel, and precludes the possibility of a wobbly shaft.

Simplified Ammeter

An automobile ammeter that has no electrical coils or connections and is very simple and rugged in construction, has recently been developed by the Westinghouse Electric & Manufacturing Company. Although designed primarily for automobile use, its compactness, reliability, and low price make this instrument, which is known as the type BT Ammeter, particularly well adapted for use also on motor boats, aerial craft, farm lighting plants, radio sets, and for charging batteries.

The design of the BT ammeter involves a radical departure from the principles used in all previous ammeters in that no wire connections or coils are used. The case of the instrument has a magnetic yoke or loop projecting to the rear, through which is passed the current carrying cable or wire, which functions as a coil. The yoke has pole pieces extending into the inside of the ammeter. These poles vary in magnetic polarity and strength, corresponding to the direction and strength of the current passing through the wire and, being made of a special alloy steel, act without any residual magnetism error which would change the zero of the instrument. There is also a fixed permanent magnet inside the instrument with poles located at right angles to the poles formed by the yoke. Pivoted on a shaft in the center of this group of poles is a soft iron vane which takes up a position corresponding to the relative strength of the permanent, and the electro-magnetic poles. The shaft carries the usual pointer which indicates the value of the current on a dial. The movement is so balanced that car shocks or swaying will not cause the pointer to swing.

This peculiar construction, which was made possible by the development in the Westinghouse laboratories of the new non-residual steel alloy, reduces by more than fifty per cent the number of necessary parts and greatly increases the reliability and strength of the instrument. It also makes installation extremely simple, for, instead of wiring the meter to the car system by means of two pieces of wire or cable with connections and clips, the only operation necessary is to pass the dash board cable through the opening in the back of the instrument. Other important advantages of this new construction are that all possibility of ground is eliminated; there can be no short circuits or burn-outs; no amount of overload will injure the meter; and no loosening of connections.

New Broadcasting Map

The Radio Section of the Department of Commerce has found it necessary to use a larger broadcasting map, the old one having become too small for practical use in locating the 564 broadcasting stations now in existence. The new map, which is 5 by 7 feet in size, is divided into radio districts, and each station is located in position.

Corrected List of U. S. Stations Alphabetically by Call Signals

KDKA, E. Pittsburgh, Pa., 400 and 485 only. 2,000 mi. Westinghouse Elec. & Mfg. Co. Daily ex. Sun, 10-10:15 am, 12:30-1 pm, music; 3:00, sports; 7:00-9, news, features, markets, entertainments; 9-9:55, concert; 9:55-10 pm, time. Sun, 10:45 am, church service; 2:45 pm, Bible story; 3 pm, 7:30, church service. Eastern.

KDN, San Francisco, Calif. 485, 510 also. 500 mi. Leo J. Meyberg Co. Fairmont Hotel. Daily, 1-2 pm, 8:30-9, 4:30-5:30, 7-7:15, music, reports, concert, Pacific.

KDOW, New York, N. Y. S. S. America. Home port is New York.

KDPM, Cleveland, O. Westinghouse Elec. & Mfg. Co.

KDPT, San Diego, Calif. 250 mi. Southern Elec. Co. Daily 7:30-9 pm, news, weather, concerts, lecture. Pacific.

KDYL, Salt Lake City, Utah. 485 also. 500 mi. Telegram Pub. Co.

KDYM, San Diego, Calif. Savoy Theater.

KDYN, Red Wood City, Calif. Great Western Radio Corp.

KDYD, San Diego, Calif. Carlson & Simpson.

KDYQ, Portland, Ore. Oregon Inst. of Technology.

KDYR, Pasadena, Calif. Pasadena Star-News Pub. Co.

KDYS, Great Falls, Mont. 485 also. 1,000 mi. Great Falls Tribune. Daily 12 m, weather, time. Daily ex Tues, 8-10 pm, concert, etc. Sun, 4 pm, church services. Mountain.

KDYU, Klamath Falls, Ore. Herald Pub. Co.

KDYV, Salt Lake City, Utah. Cope & Cornwell Co.

KDYW, Phoenix, Ariz. Smith, Hughes & Co.

KDYX, Honolulu, T. H., Hawaii. 500 mi. Honolulu Star-Bulletin Co. Ltd. Daily ex Sun, 12:15-1:15 pm, reports; 6:30-7:30 pm, entertainment, music, talks, Sun, 11 am-12:15 pm, 5-6, church services. 120th Meridian.

KDZA, Tucson, Ariz. Arizona Daily Star.

KDZB, Bakersfield, Calif. Frank E. Siefert.

KDZD, Los Angeles, Calif. W. R. Mitchell.

KDZE, Seattle, Wash. 300 mi. Rhodes Co. Daily ex Sun, 10:30-11 am, news, 3:30-4:30 pm, style talks, music. Mon, Wed, Fri, 7:15-8:15 pm, concert. Pacific.

KDZF, Los Angeles, Calif. Automobile Club of Southern California.

KDZG, San Francisco, Calif. Cyrus Pierce & Co.

KDZH, Fresno, Calif. 485 also. 50 mi. The Herald-Buford Co. Daily ex Sun, 8:15 am, 4-6 pm, news, reports. Daily ex Tues, Fri, 7-8 pm, reports, music. Tues, Fri, 8-9 pm, Pacific.

KDZI, Seattle, Wash. Seattle Radio Assn.

KDZJ, Eugene, Ore. Excelsior Radio Mfg. Co.

KDZK, Reno, Nev. 50 mi. Nev. Mchy. & Elec. Co. Wed, Fri, Sat, Sun, 8-9 pm, music, entertainment. Pacific.

KDZL, Ogden, Utah. Rocky Mountain Radio Corp.

KDZM, Centralia, Wash. 50 mi. Hollingworth Hdwe. & Radio Supply Store. Daily ex Sat & Sun, 8-9 pm, music. Pacific.

KDZP, Los Angeles, Calif. Newberry Elec. Corp.

KDZQ, Denver, Colo. 500 mi. Wm. D. Pyle. Daily ex Sun, 6:45-7:15 pm, news, 9-10 pm, concert. Mountain.

KDZR, Bellingham, Wash. 200 mi. Bellingham Pub. Co. Daily ex Sun, 7-8 pm, 8:30-9 pm, music, news, sports, reports. Sun, 7-8 pm, church service. Pacific.

KDZT, Seattle Wash. Seattle Radio Assn.

KDZW, San Francisco, Calif. Claude W. Gerdes.

KDZX, San Francisco, Calif. Glad Tidings Tabernacle.

KDZZ, Everett, Wash. 50 mi. Kinney Bros. & Seppell. Daily ex Sun, 2:30-3:30 pm, 4:30-5:30, 8:15-9:15. Pacific.

KFAB, Portland, Ore. Pacific Radiofone Co.

KFAC, Glendale, Calif. 355 and 485. 250 mi. Daily Press. Daily ex Sun, 4:15-5:15 pm, news etc. Mon, Wed, Fri, 7-8 pm, concert. Pacific.

KFAD, Phoenix, Ariz. 485 also. 100 mi. Mon, Wed, Fri, 8-9:15 pm, concert, weather, stocks, markets. Sun. morning, church service. Mountain.

KFAE, Pullman, Wash. 200 mi. State College of Wash. Program irregular.

KFAF, Denver, Colo. 1,000 mi. Western Radio Corp. Daily ex Thurs & Sun, 8-9 pm, music, reports, news. Mountain.

KFAJ, Boulder, Colo. 250 mi. Univ. of Colo. No definite schedule. Mountain.

KFAN, Moscow, Idaho. The Elec. Shop.

KFAP, Butte, Mont. Standard Pub. Co.

KFAQ, San Jose, Calif. City of San Jose.

KFAR, Hollywood, Calif. Studio Lighting Service Co.

KFAS, Reno, Nev. 300 mi. Reno Motor Supply Co. Mon, Tues, Thurs, 8-9 pm, music.

KFAT, Eugene, Ore. 100 mi. Pac. Radio Co. Tues, Thurs, Sat, 7-8 pm, music. Sun, 8:45-9-15 pm, church service.

KFAU, Boise, Ida. 485 also. 200 mi. Boise H. S. Mon, Wed, Fri, 9:30-10 am, 2:30-3:00 pm, reports, news, 8:15-9 pm, concert. Tues, Thurs, Sat, 9:30-10 am, 2:30-3:00 pm, reports, news, 7:45-8:15 concert. Mountain.

KFAV, Venice, Calif. Abbott Kinney Co.

KFAW, Santa Ana, Calif. 485 also. 100 mi. Radio Den. Daily ex Sun. 4-4:30 pm, news, reports, music. Mon, Thurs, 8-9 pm, concert. Pacific.

KFAY, Central Point, Ore. 500 mi. W. J. Virgin Milling Co. Mon, Fri, 9-10 pm. Wed, 9-12 pm. Special programs other days. Pacific.

KFBA, Lewiston, Idaho. Ramey & Bryant Radio Co.

KFBB, Havre, Mont. F. A. Buttrey & Co.

KFBC, San Diego, Calif. 100 mi. W. K. Azbill. Thurs, Sat.

KFBD, Hanford, Calif. 100 mi. Calif. Radio Lab. Daily ex Sun, 3-4 pm, 8-9. Sun, 5-6 pm. Pacific. Clarence V. Welch.

KFBE, San Luis Obispo, Calif. R. H. Horn. Daily ex Sun. 4-5 pm, 7-8. Pacific.

KFBG, Tacoma, Wash. First Presbyterian Church.

KFBH, Marshfield, Ore. Thomas Musical Co.

KFBJ, Boise, Idaho. 170 mi. Boise Radio Supply Co. Daily ex Sun. 5-5:30 pm, police reports, music. Mon, Wed, Fri, 7:45-8:15 pm, concert, Tues, Thurs, Sat, 8:15-9 pm, concert. Mountain.

KFBK, Sacramento, Calif. 300 mi. Kimball-Upson Co. Daily ex Sun, 3-4 pm, 6-6:30, concert, news. Sun. 8-9 pm, church service. Pacific.

KFBL, Everett, Wash. Leese Bros.

KFBM, Astoria, Ore. Cook & Foster.

KFBN, Calif. Borch Radio Corp. (Portable).

KFBQ, Prescott, Ariz. Savage Elec. Co.

KFBU, Laramie, Wyo. Bishop N. S. Thomas.

KFBV, Colorado Springs, Colo. Clarence O. Ford.

KFC, Seattle, Wash. 700 mi. Northern Radio & Electric Co. Daily, eight hours, miscellaneous. Pacific

KFCB, Phoenix, Ariz. 500 mi. Nielsen Radio Supply Co. Mon, Wed, Fri, 8-9 pm, music. Tues, 8-10, sports. Mountain.

KFCC, Wallace, Ida. 380 only. 100 mi. Auto Supply Co. Daily, 7:30-8:30. Pacific.

KFCD, Salem, Ore. 100 mi. F. S. Barton. Daily ex Sun, 12-1 pm, 8-9, music, news. Sun, 3-4 pm, church service. Pacific.

KFCF, Walla Walla, Wash. Frank A. Moore.

KFCH, Billings, Mont. Elec. Service Station.

KFCK, Colorado Springs, Colo. Colorado Springs Radio Co.

KFDA, Baker, Ore. Adler's Music Store.

KFDB, San Francisco, John D. McKee.

KFDD, Boise, Ida. St. Michaels Cathedral.

KFDS, San Francisco, Calif. John D. McKee.

KFEB, Taft, Calif. City of Taft.

KFEC, Portland, Ore. Meier & Frank Co.

KFFA, San Diego, Cal., Dr. R. C. Shelton.

KFED, Polytechnic, Mont., Billings Polytechnic Institute.

KFFE, Pendleton, Ore. Eastern Oregon Radio Co.

KFI, Los Angeles, Calif. 500 mi. Earle C. Anthony, Inc. Daily ex Sun, 1-1:30 pm. Daily ex Mon & Fri, 7:40-8:20 pm. Tues, Sat, 2-3 pm. Sun, 10:45-11 am, 4-5 pm. 7:40-8:20. Pacific.

KFV, Yakima, Wash. 250 mi. Foster-Bradbury Radio Store. Daily ex Sun, 3-4 pm. Mon, Wed, Fri, 8-9 pm. Pacific.

KFZ, Spokane, Wash. 300 mi. Doerr Mitchell Elec. Co. Tues, Wed, Fri, Sat, 7-8:30 pm, music, etc. Pacific.

KGB, Tacoma, Wash. 200 mi. Tacoma Daily Ledger-Willian A. Mullins Elec. Co. Daily ex Sun, 7-9 pm. Sun, 5-7:30 pm. Entertainment, news, weather, tides, police reports. Pacific.

KGF, Pomona, Cal. 150 mi. Pomona Fixture & Wiring Co. Thurs, 7:30-8:15 pm, news, markets, concert. Mountain.

KGG, Portland, Ore. 500 mi. Hallock & Watson Radio Service. Daily ex Sun. 5-6 pm, music, entertainment, 7:30-8 pm, reports. Sun, 9-10, music. Pacific.

KGN, Portland, Ore. 100 mi. Northwestern Radio Mfg. Co. Irregular schedule.

KGD, Altadena, Calif. 350 only. 300 mi. Altadena Radio Lab. Mon, Wed, Fri, 5:15-6 pm, reports, code lessons, agriograms, Tues, Thurs, 7:40-8:20 pm, concerts. Sat, 7:40-9 pm, concert. Sun, 2-3 pm, church service. Pacific.

KGU, Honolulu, Hawaii. 485 also. 150 mi. The Honolulu Advertiser. Daily, 7:30-9 pm. Tues, Thurs, Sat, special program. 150th meridian. (Three hours later than Pacific.)

KGW, Portland, Ore. 200 mi. Ship Owners Radio Service Inc. (Daily Oregonian.) Daily, 3:30-4:30 pm, news etc. Mon, 7:30-8:30 pm, concert. Wed, 8-10 pm, concert. Fri, 8-9 pm, concrt. Sun, 7-8 pm, church service. Pacific.

KGY, Lacey, Wash. 50 mi. St. Martins College. Tues, Fri, Sun, 8:30-9:30 pm, news, concert, bedtime story. Pacific.

KHD, Colorado Springs, Colo. 485 also. 50 mi. Daily ex Sun. 8:15 am, weather. Daily ex Sun, Mon, 7-7:30 pm, music. Mountain.

KHJ, Los Angeles, Calif. 485 also. 500 mi. Times Mirror Co. 400 also. Daily ex Sat & Sun, 1:30-2:15 pm, 6:40-7:20. Sat, 6:40-7:20 pm. Sun, 10-10:45 am. Pacific.

KHQ, Seattle Wash. Louis Wasmer.

KJC, Los Angeles, Calif. 100 mi. Standard Radio Co. Barker Bros. Daily ex Sun, 11:30-12 noon. Mon, 10-11 am. Wed, 9-10 am. Sun, 1-2 pm, 5-6 Pacific.

KJJ, Sunnyvale, Calif. 500 mi. Radio Shop. Tues, 8:15-9 pm. Fri, 7:30-8:15 pm. Pacific.

KJQ, Stockton, Calif. C. O. Gould.

KJR, Seattle, Wash. 200 mi. Northwest Radio Service Co. Daily ex Sun, 8-9 pm, miscellaneous. Pacific.

KJS, Los Angeles, Calif. 100 mi. Bible Inst. of Los Angeles. Tues, Wed, 12-12:30 pm, sacred music, lecture. Sun, 11:30-12:30 pm, sacred music, sermon. Pacific.

KLB, Pasadena, Cal. 300 mi. J. J. Dunn Co. Mon and Fri, 7:30-8:15 pm, concert. Sun, 3-4 pm and 8-9, concert. Pacific.

KLN, Del Monte, Calif. Monterey Elec. Shop. Daily. 12-1 pm, weather, markets, news; 7-8 pm, concerts. Pacific.

KLP, San Francisco, Calif. 500 mi. Colin B. Kennedy Corp. Mon, 7:30-8:30 pm. Thurs, 8:30-9 pm. Sun, 4-5 pm. Pacific.

KLS, San Francisco, Calif. 390 mi. Warner Bros. Radio Supply Co. Daily, 12-1 pm. Sat, 7:30-8:15 pm. Pacific.

KLX, Oakland, Calif. 500 mi. Oakland Tribune. Daily ex Sun. 7:15-7:30 pm, news, entertainment. Tues, 7:30-8:15 pm, Fri, 8:15-9 pm, and Sun, 3-4 pm, concert. Pacific.

KLZ, Denver, Colo. 485 also. 200 mi. Reynolds Radio Co. Daily ex Sun, 7:30 pm on, news, markets, bedtime story, concert. Sun, 8-9 pm, church service. Mountain.

KMAZ, Mercer Univ. Macon, Ga.

KMC, Reedley, Calif. 100 mi. Lindsay-Weatherill & Co. Mon, Wed, Fri, 8:30-9 pm, concert. Pacific.

KMJ, Fresno, Calif. 200 mi. San Joaquin Lt. & Pr. Corp. Tues, Fri, 7-8 pm, music. Sun, 5-6 pm, music. Pacific.

KMO, Tacoma, Wash. 200 mi. Tacoma Times. (Love Electric Co.) Daily ex Sun, 11-1 pm, 6-7, 9:15-10, concert, news, lecture. Pacific.

KNI, Eureka, Calif. T. W. Smith.

KNJ, Roswell, New Mex, 485 also. 750 mi. Roswell Public Service Co. Daily, 8 pm, news, reports, concerts. Mountain.

KNN, Los Angeles, Calif. 100 mi. Bullock's. Mon, 2:30-3:30 pm. Wed, 2:15-3 pm. Thurs, 4-5 pm. Pacific.

KNT, Aberdeen, Wash. 400 mi. Grays Harbor Radio Co. Daily, 5-5:30 pm, 7:30-8:15, news, concert. Pacific.

KNV, Los Angeles, Calif. Radio Supply Co.

KNX, Los Angeles, Calif. Elec. Lighting Supply Co.

KOB, State College, N. M. 485 also. 500 mi. N. M. College Agrl. & Mech. Arts. Daily ex Sun. 11:55-12 m, reports. Mon, Wed, Fri, 7:30-8:30 pm, concert. Mountain.

KOG, Los Angeles, Calif. 300 mi. Western Radio Elec. Co. Daily ex Sun. Wed, 5-5:30 pm, code, news. Mon, Fri, 7:40-8:20 pm, music. Wed, 4:30-5 pm, code, 8:20-9 pm, music. Pacific.

KON, Los Angeles, Calif. 200 mi. Holzwasser Inc. Daily ex Sun, 4-5 pm and 8:15-9, concert, news. Sun, 10-11 am, 4-5 pm and 8:15-9, church service. Pacific.

KOP, Detroit, Mich. Detroit Police Dept.

KPO, San Francisco, Calif. 300, 600 also. 500 mi. Hale Bros., Inc. Daily ex Sun, 11-12 m, 3:30-4:30 pm, concert. Wed, 7:30-8:15 pm, concert. Sun, 11-12:15 pm, church service. Pacific.

KQI, Berkeley, Calif. Univ. of Calif.

KQP, Hood River, Ore. 360 only. 50 mi. Hood River News. Daily ex Sat, Sun, 7 pm, news. Tues, Fri, Sun. 8:30-9:30 entertainment. Pacific.

KQV, Pittsburgh, Pa. 300 mi. Doubleday-Hill Elec. Co. Daily ex Sun, 12-12:30 pm, 2:30-3, music, lectures. Mon, Wed, Fri, 10-11 pm, music, entertainment. Eastern.

KQW, San Jose, Calif. 345 also. 500 mi. Chas. D. Herrold. Daily ex Sun, 1-1:30 pm. Wed, 8:15-9 pm, concert. Pacific.

KQY, Portland, Ore. 200 mi. Stubbs Elec. Co. Daily, 1-2 pm, 6-7. Pacific.

KRE, Berkeley, Calif. 200 mi. Maxwell Elec. Co. Every other Sat, 8:15-9 pm. Sun, 1-2 pm, 6-7. Pacific.

KSD, St. Louis, Mo. 360 & 485 only. 1,500 mi. St. Louis Post-Dispatch. Daily ex Sun, 9:40 am, 10:40, 11:40, 12:40 pm, 1:40, 2:40, 4, 8. Sun, 8:15 pm. Central.

KSL, San Francisco, Cal. 50 mi. The Emporium. Daily ex Sun, 10-11 am, concert, news; 2-3 pm, concert, educational talk. Sun, 2-3 pm, concert and educational talk. Pacific.

KSS, Long Beach, Calif. 25 mi. Prest & Dean Radio Research Lab. Daily ex Sun, 3:30-4:30 pm, news, concert. Pacific.

KSU, Wenatchee, Wash., 360 and 485.

KTW, Seattle, Wash. 500 mi. First Presbyterian Church. Sun, 11-12:30 pm, 3-4-30, 7-9-30, church service. Pacific.

KUO, San Francisco, Calif. 485, 525 also. 1,500 mi. San Fran. Examiner. Daily ex Sun. 9-10 am, concert, chat to housewives; 11-12, reports; 3-3-30 pm, lecture, news; 5:30-6:45 pm, concert; 9 am, 12 m, 6:45 pm, weather report. Wed, 3:30 pm, health bulletins. Sun, 9-10 am, concert; 5-6 pm, concert, news. Pacific.

KUS, Los Angeles, Calif. City Dye Works & Laundry Co.

KUY, El Monte, Calif. 500 mi. Coast Radio Co. Daily ex Sun, Sat, 4-4:45 pm. Mon, Thu, 8:20-9 pm. Sat, 3-4 pm. Pacific.

KVQ, Sacramento, Calif. 300 mi. James McClatchy. Daily ex Sun, 6:30-7:30 pm, news, reports, music. Sun, 6-7 pm, reports, music. Pacific.

KWG, Stockton, Cal. 1,500 mi. Portable Wireless Telephone Co. Daily ex Sun, 4-5 pm, news, concert, markets. Tues and Fri, 8-9 pm, concert. Sun, 2-3 pm, concert. Pacific.

KWH, Los Angeles, Calif. 485 also. 250 mi. Examiner, Daily ex Sun, 1:30-1:40 pm, 5:30-6, 6-6:15, 8:20-9, reports, entertainment. Sun, 8:30-9 pm, church service. Pacific.

KXD, Modesto, Calif. Herald Pub. Co.

KXS, Los Angeles, Calif. Braun Corp.

KYF, San Diego, Calif. Thearle Music Co.

KYG, Portland, Ore., Radio Service Bureau, Inc.

KYI, Bakersfield, Calif. Bakersfield, California. (Alfred Harrell.)

KYJ, Los Angeles, Cal. 485 also. 1,000 mi. Leo J. Meyberg Co. (Hamburgers). Daily ex Sun, 4-5 pm, concert, markets, weather, news. Mon, Thurs, Sat, 8-9 pm, same program. Pacific.

KYQ, Honolulu, T. H. Electric Shop.

KYW, Chicago, Ill. 400, 485 only. 1,500 mi. Westinghouse Elec. & Mfg. Co. Daily ex Sun, 9:35 am-1:20 pm, market quotations every half hr; 2:15, news, markets; 4:15 and 6:30, news, final markets and stocks; 7:30, bedtime story; 7:45, feature; 8-9, concert; 9, news. Sun. 3:30 pm, church service. Central.

KYY, San Francisco, Calif. The Radio Telephone Shop.

KZC, Seattle, Wash. 100 mi. Public Market & Department Store Co. Daily ex Sun, 6:45-7:15 pm, music, news, agriograms. Pacific.

KZM, Oakland, Calif. 200 mi. Western Radio Institute (Hotel Oakland). Daily ex Sun, 6:45-7 pm, news. Pacific.

KZN, Salt Lake City, Utah. 485 also. 1,000 mi. Desert News. Daily ex Sun, 3-4 pm, reports, music, 8-9:30 pm, music, news, bedtime stories etc. Mountain.

KZV, Wenatchee, Wash. Wenatchee Battery & Motor Co.

KZY, San Francisco, Calif. Atlantic-Pacific Radio Supplies Co.

NDF, Anacostia, D. C. 412 only. 600 mi. U. S. Navy Dept. Mon, Tues, Thur, 7:15-7:30 pm, lecture. Mon, Thur, 6:45-7 pm, lecture. Tues, Thur, 7:45-8 pm, health lecture. Wed, Fri, 8:30-9:45 pm, band concert. Eastern.

PWX, Havana, Cuba, Cuban Telephone Co.

WAI, Dayton, O. McCook Field, U. S. Army.

WAAB, New Orleans, La. Valdemar Jensen.

WAAC, New Orleans, La. Tulane Univ.

WAAD, Cincinnati, O. 200 mi. Ohio Mechanics Inst. Fri, 2:30-4:30 pm, and Sat, 8:15-10:15 pm, Cincinnati Symph. Orchestra concert. Central.

WAAF, Chicago, Ill. 485 only. 300 mi. Chi. Daily Drovers Journal. Daily ex Sat & Sun, 8:30 am, 10:30, 10:45, 12:30 pm, 3, 4:30, stock reports. Central.

WAAG, Shreveport, La. 50 mi. Bordeaux Co. Daily ex Sun, 7:30-9 pm, sports, concert. Central.

WAAH, St. Paul, Minn. 200 mi. Commonwealth Elec. Co. Mon, Fri, 12-12:45 pm, concert. Mon, Tues, 8-9:30, music. Wed, 1-1:45 pm, lecture. Sun, 3:30-4:30 pm, concert. Central.

WAAJ, Boston, Mass. 50 mi. Eastern Radio Inst. Mon, Wed, Fri, 9-10 pm, music. Eastern.

WAAK, Milwaukee, Wis. 485 also. 300 mi. Gimbel Bros. Daily ex Sun, 10 am, markets, weather; 11, markets; 12:10 pm, markets; 1:25, closing markets; 2, and every hr. after, concert, test; 7, weather; 7:15, baseball; 7:30, concert. Central.

WAAM, Newark, N. J. 300 mi. I. R. Nelson Co. Daily ex Sun, 11-11:55 am, 3-4 pm, music. Wed, 8-9 pm, special program. Eastern.

Corrected List of U. S. Stations Alphabetically by Call Signals

WAAN, Columbia, Mo. Univ. of Missouri.
WAAO, Charleston, W. Vs. 40 mi. Radio Service Co. Daily ex Sun, 6:45-7:45 pm, music, news, weather, baseball. Eastern.
WAAP, Wichita, Kan. 200 mi. United Elec. Co. Daily, 12-1:30 pm, music, news; 5, weather; 7:15-7:30, sports, markets; 9:45-12, talks, music, and code on C. W.; 10:30, weather. Tues, Fri, 8 pm on, concert, etc. Central.
WAAQ, Greenwich, Conn. 600 mi. New England Motor Sales Co. Daily ex Sun, 9:30 am-5:30 pm, every half hr. Eastern.
WAAR, Huntington, W. Va. Groves-Thornton Hdw. Co.
WAAS, Decatur, Ga. Georgia Radio Co.
WAAT, Jersey City, N. J. 70 mi. Jersey Review. Wed, 7-8 pm, concert, lecture. Sun, 7-8, church service, concert. Eastern.
WAAV, Athens, O. 500 mi. Athens Radio Co. Daily, 7-9 pm, miscellaneous. Central.
WAAW, Omaha, Neb. 485 also. 500 Omaha Grain Exchange. Daily ex Sun, 9:45, 10:45, 11:45, 12:45, 1:20, 8 pm, market reports. 8:15-9 pm, music. Central.
WAAX, Crafton, Pa. Radio Service Corp.
WAAY, Youngstown, O. 500 mi. Yohrling Rayner Music Co. Daily ex Sun, 5:30 pm, reports; 8:15-9 pm, music. Esstern.
WAAZ, Emporia, Kans. 250 mi. Hollister-Miller Motor Co. Daily ex Sun, 7-8 pm, weather, entertainment. Centrsl.
WAH, El Dorado, Kans. Midland Refining Co.
WAJT, Marshall, Mo. Kelly-Vawter Jewelry Co.
WAJU, Yankton, S. D. Yankton College.
WBAA, W. Lafayette, Ind. 50 mi. Purdue University. Fri, 7:15-7:30 pm, educational lecture. Central.
WBAB, Syrscuse, N. Y. 1,000 mi. Syracuse Radio Tel. Co. Mon, Wed, Sat, 7:30-9:30 pm, concert, agriogrsms etc. Eastern.
WBAD, Minneapolis, Minn. Sterling Elec. Co. (Journal Printing Co.)
WBAE, Peoria, Ill. Bradley Polytechnic Inst.
WBAF, Moorestown, N. J. Fred M. Middleton.
WBAG, Bridgeport, Pa. 485 also. 300 mi. Diamond St. Fibre Co. Daily, 11:45-12 m, markets, weather. Eastern.
WBAH, Minneapolis, Minn. 200 mi. The Dayton Co. Daily ex Sun, 1-1:30 pm, 3-3:30, 5-5:30, 9:30-10, Sat, 11-11:30 am. Wed, 8-10 pm. Central.
WBAJ, Toledo, O. 300 mi. Marshall-Gerken Co. Daily ex Sun, 12:05-2 pm, 6-7:30, news, music, reports, Tues, Thur, Sat, 8-9 pm, concert. 485 also. Eastern.
WBAN, Paterson, N. J. 100 mi. Wireless Phone Corp. Daily ex Sun, 10:30 am, on the hour to 9:30 pm, concert, bsseball. Eastern.
WBAD, Decatur, Ill. James Millikin Univ.
WBAQ, Mishawaka, Ind. 200 mi. Lyrodion, Mfg. Co. Tues, Thur, Sat, 7 pm. Sun, 2 pm. Central.
WBAP, Fort Worth, Texas. 400 and 485 only. 1,500 mi. Ft. Worth Star Telegram. Daily ex Sun, 9:45-10 am, 11-11:30, 3-3:30 pm, 3:45-4, 5:15-5:30, 6:30-6:45, 9:30-10:30, news, reports, concert. Central.
WBAU, Hamilton, O. Republican Pub. Co.
WBAV, Columbus, O. 485 also. 300 mi. Erner & Hopkins Co. Daily ex Sun, 12:30 pm, news, weather. Mon, 7 pm, music. Central.
WBAW, Marietta, O. Marietta College.
WBAX, Wilkes-Barre, Pa. 200 mi. John H. Stenger, Jr. Three nights of week, not regular.
WBAY, New York, N. Y. 400 only. 1,500 mi. A. T. & T. Co. Daily, 11-12 am, 4:30-5:30 pm. Thurs, 7:30 pm on Eastern daylight saving.
WBL, Anthony, Kans. 200 mi. T & H Radio Co. Mon, Wed, Fri, 10-11 pm, concert, lecture. Sat, 11-12 pm, concert. Sun, 10 am, 4-5 pm, church service. Central.
WBS, Newark, N. J. 100 mi. D. W. May, Ind. Mon, Wed, Thur, 7:30-8:30 pm, reports, music. Sun, 9-10:30 am, 1-3 pm, church service. Eastern.
WBT, Charlotte, N. C. 485 also. 500 mi. Southern Radio Corp. Daily ex Sun, 11 am, reports, 8 pm, music. Sun, 7:30 pm, church service. Eastern.
WBU, Chicago, Ill. City of Chicago.
WBZ, Springfield, Mass. 400 only. 500 mi. Westinghouse Elec. & Mfg. Co. Daily ex Sun, 7:30 pm, children's hour; 7:15, markets, weather, lecture; 8-9, concert. Sun, 3 and 8, church service. Eastern.
WCAB, Newburgh, N. Y. 150 mi. Newburgh Daily News. Daily ex Sun, 1 pm, 2, 3, 7, Mon, Fri, 10:30 pm. Eastern.
WCAC, Fort Smith, Ark. 500 mi. John Fink Jewelry Co. Fri, Sun, 8-10 pm, music, talks, sermon. Central.
WCAD, Canton, N. Y. 200. 480 also. 300 mi. St. Lawrence Univ. No regular schedule. Eastern.
WCAE, Pittsburgh, Pa. Kaufman & Baer Co.
WCAG, New Orleans, La. Daily States Pub. Co.
WCAH, Columbus, O. 150 mi. Entrekln Elec. Co. Tues, Fri, 7-9 pm, music. Wed, Thur, Sat, 7-8 pm, music. Sun, 10-12:30, church service. Central.
WCAI San Antonio, Tex. Southern Equipment Co.
WCAJ, Univ. Place, Neb. 485 also. 100 mi. Neb. Wesleyan. Univ. Daily ex Sun, 11 am, weather, news. Wed, 9 pm, music, lecturc. Central.
WCAK, Houston, Tex. 100 mi. Alfred P. Daniel. Daily ex Sun, 7-7:15 pm, music. Wed, 8-9:15, concert. Sun, 3-4:30 pm, concert. Central.
WCAL, Northfield, Minn. 500 mi. St. Olaf Collogc. Thur, 11 pm, music. Sun, 8:30 pm, music, concert, lecture. Central.
WCAM, Villanova, Pa. Villanova College.
WCAO, Baltimore, Md. 100 mi. Sanders & Stayman Co. Daily ex Sun, 12-12:20 pm, 5-5:20. Mon, Wed, 7:30-8:30 pm. Eastern.
WCAP, Decatur, Ill. Central Radio Service. Also 485.
WCAQ, Deflance, O. 200 mi. Tri-State Radio Mfg. Co. Daily, 11:30-12:30 pm, 3, baseball; 6-6-30, baseball, concert; 8, special program. Central.
WCAR, San Antonio, Tex. 200 mi. Alamo Radio Elec. Co. Mon, Thurs, Sat, 8:30-9:30 pm, concert. Sun, 11 am, church service. Central.
WCAS, Minneapolis, Minn. 200 mi. Wm. H. Dunwoody Industriai Inst. Mon, 8-8:45 pm, music, lectures. Central.
WCAT, Rapid City, S. Dak. 485 also. 300 mi. S. Dak. School of Mines. Daily ex Sun, 9:30-12:30 pm, weather. Mountain.
WCAU, Philadelphia, Pa. Phila. Radiophone Co. 485 also.
WCAV, Little Rock, Ark. J. C. Dice Elec. Co.
WCAX, Burlington, Vt. Univ. of Vt.
WCAY, Milwaukee, Wis. Kesselman O'Driscoll Co.
WCAZ, Quincy, Ill. Whig-General.
WCE, Minnespolis, Minn. Findley Elec. Co.
WCJ, New Haven, Conn. 400 mi. A. C. Gilbert Co. Mon, Wed, Tbur, 7:30-8:30 pm, news, music. Eastern.
WCK, St. Louis, Mo. 485 also. 50 mi. Stix Baer & Fuller (Grand Lesder). Mon, Wed, Fri, 6:45-8 pm, concert, lecture, bedtime story. Central.
WCM, Austin, Tex. Univ. of Texas.
WCN, Worcester, Mass. 485 also. 100 mi. Clark Univ. Daily, 11:15 am, 5:15 pm, weather. Evening progrsm irregular. Eastern.
WCX, Detroit, Mich. Detroit Free Press.
WDAA, Nashville, Tenn. Ward Belmont School.
WDAC, Springfield, Ill. Ill. Watch Co.
WDAE, Tampa, Fla. 485 also. 500 mi. Tampa Daily Times. Wed, Fri, 8-10 pm, music, lecture. Eastern.
WDAF, Kansas City, Mo. 400 and 485 only. 500 mi. Ksnsss City Star. Daily ex Sun, 3-4 pm, reports, music; 6-7, educational, bedtime story, etc. Mon, Wed, Fri, 8-10 pm, concert. Sun, 3:30-5:30 pm, music. Central.
WDAG, Amarillo, Tex. K. Laursnce Martin.
WDAH, El Psso, Texas. 485 also. 300 mi. Mine & Smelter Supply Co. Daily ex Sun, 10 am, news, reports. Tues, Thurs, Sat, 7:30-8:30 pm, music. Mountain.
WDAI, Syracuse, N. Y. 485 also. 200 mi. Hughes Radio Corp. Daily ex Sun, 12 m, reports. Wed, Sat, evening concert.
WDAJ, College Park, Ga. 485 also. 300 mi. A. & W. P. R. R. Co. Daily, 9-10 pm, concert etc. Central.
WDAK, Hartford, Conn. 150 mi. Hartford Courant. Daily ex Sun, 2:30 pm, 3:30, 4:30, 5:30, music, 7:40, bedtime story; 8:15, concert. Eastern.
WDAL, Jacksonville, Fla. 485 also. 250 mi. Florida Times Union. Daily, 11 am, time, weather, 3-3:15, 4-4:15, 5-5:15, 8-9:30 music. 10:05-10:20 pm, reports, Eastern.
WDAN, Shreveport, La. Centenary College and Glenwood Radio Corp.
WDAO, Dallas, Tex. Automotive Elec. Co.
WDAP, Chicago, Ill., Midwest Radio Central, 485 also; 1000 mi., 11:45-12 M, Amplco Selections on Piano; 1:45-2:15 latest phonograph selections; 3:15-3:30, closing quotations on Chicago Stock exchange. 6:00-6:15 pm, latest news bulletin daily except Saturday and Sunday. Saturday 11:45-12 Concert; 1:15-1:30 pm, Closing quotations Chicago Stock Exchange. Tues, and Thurs. 10:00-1:00, regular concert; Saturday, 10 pm. to 2 am, dance program; Sunday night, 8:30-11:00, concert.
WDAQ, Brownsville, Pa. 200 mi. Hartman-Riker Elec. & Mach. Co. Daily ex Sun, 10:30-10:50 sm, music; 12:50-1:10 pm, music, news, weather; 5:05-5:30 music. Tues, Thurs, Fri, 9:15-10 pm, concert. Sun, 5 pm, chapel. Eastern.
WDAR, Philsdelphia, Pa. Lit Bros.
WDAS, Worcester, Masss. Samuel A. Waite.
WDAU, New Bedford, Mass. 50 mi. Slocum & Kilburn. Mon, Wed, 7-9 pm, concert, etc. Eastern.
WDAV, Muskogee, Okla. Daily Phoenix.
WDAW, Atlanta, Ga. 485 also. 500 mi. Georgia Ry. & Power Co. Daily ex Sun, 6-7 pm; 9-9:55. Sun, 3:30-4:30 pm. Central.
WDAX, Centerville, Iowa. 500 mi.. First Nat'l Bank. Daily ex Sun, 11:30 am, reports, news. Mon, Tbur, 7:30-9 pm, concert.
WDAY, Fargo, N. D. 485 also. 300 mi. Daily ex Sun, 12:15-12:30 pm, 7:30-8:15, reports, news, music. Central.
WDM, Washington, D. C. 50 mi. Church of the Covenant. Sun, 10:30 am, church service; 3 pm, lecture; 7:30, church service. Eastern.
WDT, New York, N. Y. Ship Owners Radio Service.
WDV, Omaha, Neb. 100 mi. John O. Yelser, Jr. Daily 7-8 pm. Tues, Sat, 12-1 am. Fri, 10-10:45 pm. Sun, 2-4 pm. Music. Central.
WDY, Roselle Park, N. J. Radio Corp. of America.
WDZ, Tuscola, Ill. 70 mi. James L. Bush. Daily ex Sun, every half hr., 8:30 am-12:15, Chicago Board of Trade quotations. Tues, Fri, 7-8 pm, concert, entertainment. Central.
WEAA, Flint, Mich. Failain & Lathrop.
WEAB, Fort Dodge, Ia. 600 mi. Standard Radio Equip. Co. Daily ex Sun, 9:40 am, 10:40, 11:40, 1:40 pm, 5:15, market reports; 6:30 pm, sports; 7:30-8:45 pm, music. Sun, 10:45 am, church service; 7:30-8:45 pm, music. Central.
WEAC, Terre Haute, Ind. Baines Elec. Service Co. 485 also.
WEAD, Atwood, Kan. 485 also. 150 mi. N. W. Kansas Radio Supply Co. Daily ex Sun, 11-11:30 am, markets, music; 12, markets; 1:45 pm, markets; on half hour 3:15 to 5:45, news sports. Tues, Wed, Thurs, Sat, 7:30-9, concert. Sun, 11 am, church service; 3 pm, sacred music; 7:30, church service. Central.
WEAE, Blacksburg, Va. Polytechnic Inst.
WEAF, New York City, N. Y. 400 only. 1,500 mi. Am. Tel. & Telg. Co. Daily ex Sun, 4:30-5:30 pm. Mon, Wed, Thur, Sat, 8-10 pm, concert. Eastern.
WEAG, Edgewood, R. I. Nichols-Hineline-Bassett Lab.
WEAH, Wichita, Kan. 485 also 500 mi. Lander Radio Co. Daily ex Sun, 9:40 am, 10:40, 11:40, 12:30 pm, 1:30, 3:15, reports. Wed, Sat, 8 pm, concert. Every third Sun, 8 pm, concert. Central.
WEAI, Ithaca, N. Y. Cornell Univ.
WEAJ, Chicago, Ill. The Benson Co.
WEAK, St. Joseph, Mo. 100 mi. Julius B. Abercromble. Thur, 8-9:45 pm, concert. Central.
WEAM, North Plainfield, N. J. 75 mi. Burough of N. Plainfield. Daily, 7:30-8 pm, music, police news, etc. Eastern.
WEAN, Providence, R. I. 50 mi. The Sbepard Co. Daily ex Sun, 3-5 pm, 6-8, music, bedtime stories. Mon, Wed, 8-10 pm, concert. Eastern.
WEAO, Columbus, Ohio. Ohio State Univ.
WEAP, Mobile, Ala. 485 also. 50 mi. Mobile Radio Co. Daily, 4-5 pm, 7-8:55. Central.
WEAQ, Berlin, N. H., Y. M. C. A.
WEAR, Baltimore, Md. Balt. American & News Pub. Co.
WEAS, Washington, D. C. 150 mi. The Hecht Co. Daily ex Sun, 3-4 pm. Wed, Sat, 7-8 pm. Eastern.
WEAT, Tampa, Fla. John J. Fogarty.
WEAU, Sioux City, Ia. 50 mi. Davidson Bros. Co. Daily ex Sun, 9 am, 10, 11, 1 pm, reports, news. Mon, Wed, Fri, 8:30 pm, concert. Central.
WEAV, Rusbville, Nebr. 200 mi. Sheridan, Elec. Service Co. Wed. Fri. Sun, 8-9 pm, concert, news, etc. Mountain.
WEAW, Anderson, Ind. Arrow Radio Lab.
WEAX, Little Rock, Ark. T. J. M. Daly.
WEAY, Houston, Tex. Will Horwltz, Jr.
WEAZ, Waterloo, Ia. 100 mi. A. C. Sweetman. Mon, Thurs, Sat, 7-8 pm, news, concert, lecture. Central.
WEB, St. Louis, Mo. 800 mi. The Benwood Co., Inc. Daily ex Sun, 9-9:40 am, 12-12:45 pm, 3-4. Wed, 7-9 pm. Central.
WEH, Tulsa, Okla. (300 S. Main St., Eldorado, Ksns.) Midlsnd Refining Co.
WEV, Houston, Tex. 485 also. 500 mi. Hurlburt-Still Elec. Co. Daily ex Sun, 10 am, 5:30 pm, weather, roads. Tues, Thur, 8 pm, concert. Central.
WEW, St. Louis, Mo. 485 also. 100 mi. St. Louis Univ. Daily ex Sun, 9 am, 10, 2 pm, reports. Central.
WEY, Wichita, Kan. 485 also. 500 mi. Cosradio Co. (Wichita Beacon.) Daily ex Sun, hourly, 8:40 am-12:40 pm, stock markets. Daily, 10:45 am and 4:30 pm, weather; 8-10 pm, sports, concert, lecture; 10:45 weather. Sun, 8:10 pm, church service, concert. Central.
WFAA, Dallas, Texas. 400 and 485 only. 250 mi. A. H. Belo & Co. Daily, 10:15 am, reports; 12:30-1 pm, address; 6:45-7, bedtime story; 8-8:30, music. Tues, Thur, Sat, 11-12 pm, music. Central.
WFAB, Syracuse, N. Y. 100 mi. C. F. Woese. No definite scheduie.
WFAC, Superior, Wis. 400 mi. Superior Radio Co. Daily, 7-7:45 pm, news. Central.
WFAD, Salina, Kan. 250 mi. Watson Weldon Motor Supply Co. Daily ex Sun, 8:45 am, 9:45, 10:45, 11:45, 1:30 pm, reports. Tues, Thur, Fri, 8 pm, concert. Sun, 11 am, church service; 8 pm, concert. Central.
WFAF, Poughkeepsie, N. Y. 200 mi. H. C. Sprstley Radio Co. Daily ex Sun, 10-10:30 am, 11:30-11:45, 1:30-2 pm, 4-4:15. Tues, Thurs, Sat, 8:15 pm, feature program. Eastern.
WFAG, Waterford, N. Y. 340 only. 300 mi. Radio Engineering Lsb. Wed, Sat, 7:45-10 pm, concert. Sun, 2-4 pm, church service. Eastern.
WFAH, Fort Arthur, Tex. Elec. Supply Co.
WFAJ, Asheville, N. C. Hi-Grade Wireless Instrument Co.
WFAK, Brentwood, Mo., Domestic Electric Co.
WFAL, Houston, Tex. Chronicle Pub. Co.
WFAM, St. Cloud, Minn. 485 also. 100 mi. Granite City Elec. Co. and Times Publishing Co. Daily ex Sun, 3:30-4:00 pm, markets; 7:30-9, entertainment. Central.
WFAN, Hutchinson, Minn. 485 also. 500 mi. Hutchinson Electric Service Co. Daily ex Sun, 1 pm, markets etc. Centrsl.
WFAP, Peoria, Ill. 200 mi. Radio School of Browns Business College. Daily ex Sun, 10:25 am, reports; 12-12:15 pm, concert; 1:40 reports; 4:25, business lessons; 7:45, concert. Central.
WFAQ, Cameron, Mo. Cameron Radio Co. and Mo. Wesleyan College.
WFAR, Sanford, Me. Hall & Stubbs.
WFAS, Fort Wayne, Ind. United Radio Corp.
WFAT, Sioux Falls, S. Dak. 485 also. 400 mi. Argus Leader. Daily ex Sun, 10:15-12:15 pm, 2:15, reports; 7:30 pm, music. Tues, 8-9 pm, concert. Central.
WFAU, Boston, Mass. Edwin C. Lewis.
WFAV, Lincoln, Nebr. 485 also. 800 mi. Univ. of Nebr. Daily ex Sun, 10:10 am, weather, markets. Sat. 9:00 pm, concert. Central.
WFAW, Miami, Fla. Daily Metropolis.
WFAX, Binghamton, N. Y. 75 mi. Arthur L. Kent. Daily, 5-5:30 pm, music. Eastern.
WFAY, Independence, Kan. 500 mi. Daniels Radio Supply Co. Daily ex Sun, 12 m, 4 pm, news. Mon, Tues, Wed, 7:30-8 pm, entertainment. Thur, Fri, 7-8:30 pm, Sat, 7-9 pm, music. Sun, 11 am, church services. Central.
WFAZ, Charleston, S. C. 400 mi. S. C. Radio Shop. Daily ex Sun, 12 m, reports, news, music. Tues, Thur, 8-10 pm. Eastern.
WFI, Philadelphia, Penn. 400 and 485 only. 350 mi. Strawbridge & Clothier. Daily ex Sun, 1:16 pm, news; 3:30-4:30, concert; 5:30-6, sports. Mon, Fri, 6:30-7 pm, Radio talk. Wed, Fri, Sat, 7:30-8:30 pm, concert. Fri, Sat, (alternate weeks) 7:30 pm, concert at 8:30 pm. Sun, 4 pm, church service. Eastern.
WFO, Dayton, O. 485 also. 300 mi. Rike-Kumler Co. Daily ex Sun, 9 am, 11, 4 pm, music, news, reports. Mon, Wed, Fri, 8 pm, concert. Sat, 11:30 pm, concert. Central.
WGAB, Houston, Tex. 250 mi. QRV Radio Co. Daily ex Sun, 8:30-9 am, police reports; 1:30-2:30 pm, concert, agriograms; 4-5, concerts, police reports. Central.
WGAC, Brooklyn, N. Y. Orpheum Radio Stores Co.
WGAD, Ensenada, Porto Rico, 250 mi. Escucla Hispano Americana de Radio Telegrafia, Inc. Sat and Sun eve.
WGAF, Tulsa, Okla. Golier Radio Service.
WGAH, New Haven, Conn. New Haven Elec. Co.
WGAJ, Shenandoah, Ia. W. H. Gass.
WGAK, Macon, Ga. Macon Elec. Co.
WGAL, Lancaster, Pa. 35 mi. Lancaster Elec. Supply & Construction Co. Mon, Wed, Fri, 7-8 pm, concert, lecture. Sun, 3-3:30 pm, church service. Eastern.
WGAM, Orangeburg, S. C. 150 mi. Orangeburg Radio Equipment Co. Daily ex Sun, 10 am, markets, weather; 11:55, time; 4 pm, Radio talk, markets, baseball; 6, music, lecture; 10, time, weather, entertainment. Sun. 11 am, church service; 11:55, time; 10 pm, time, weather, music. Eastern.
WGAN, Pensacola, Fla. Cecil E. Lloyd.
WGAQ, Shreveport, La. 500 mi. Glenwood Radio Corp. Daily ex Sun, 8 pm, music. Sun, 11 am, 7:30 pm, church service. Central.
WGAR, Fort Smith, Ark. Southwest American.
WGAS, Cblcago, Ill. 1,000 mi. Ray-di-co Organization, Inc. Daily ex Sun, 9-9:20 am, 11:15-11:30, 1:30-1:45 pm, 2:45-3, 5-6, music. 12:15-12:30 pm, 4-4:15, 4:30-4:45, reports. Wed, Fri, 10-11 pm, music. Central.
WGAT, Lincoln, Nebr. 100 mi. Am. Legion, Dept. of Nebr. Mon, Wed, 9 pm, announcements. Fri, 9-10 pm, patriotic program, concert. Sun, 3-5 pm, sermon. Central.
WGAU, Wooster, O. Marcus G. Limb.
WGAV, Savannah, Ga., B-H Radio Co.
WGAW, Altoona, Pa. Ernest C. Albright.
WGAX, Washington C H, O. 75 mi. Radio Elec. Co. Daily ex Sun, 9 am, 2 pm, music, news. Mon, Wed, Fri, 9:30 pm, concert, news. Sun, 10:30 pm, sermon. Central.

Corrected List of U. S. Stations Alphabetically by Call Signals

WGAY, Madison, Wis. 100 mi. North Western Radio Co. Daily ex Sun, 9-10 am, financial news; 11:30, news, opening markets; 4 pm, newe, closing markets. Mon, Wed, Thurs, Sat, 7:30-8:30 pm, concert. Sun, 10:30-12 am, sermon. Central.

WGAZ, South Bend, Ind. 200 mi. South Bend Tribune. Daily ex Sun, 9-9:30 am, household hints, menus; 2-3 pm, music, 7-8 pm, music. Central.

WGF, Des Moines, Iowa. 485 also. 300 mi. Register and Tribune. Tues, Fri, 7:30 pm, entertainment. Sun, 5 pm, church service. Central.

WGI, Medford Hillside, Mass. 485 also. 200 mi. Am. Radio and Research Corp. Daily ex Sun, 7 am, setting up exercises; 9:30, 11:30, 3:25 pm, music; 10:30 am, 1:30 pm, 3, 6, 6:30, reports, news. Mon, Wed, 7 pm, entertainment. Tues, 8:30 pm, fashion talks, concert. Thur, Fri, 9 pm, concert. Sat, 8 pm, concert. Sun, 4 pm, concert; 6:30 pm, reports; 7:30, church service; 8:30 concert. Eastern.

WGL, Philadelphia, Pa. 2,000 mi. Thos. F. J. Howlett. Tues, Thurs, Sat, 7:45-11:30 pm, concert. Eastern.

WGM, Atlanta, Ga. 400 only. Atlanta Constitution.

WGR. Buffalo, N. Y. 485 also. 300 mi. Federal Tel. & Telg. Co. Daily ex Sat and Sun, 12:15 pm, weather, agriograms; 2, music; 3, lecture; 4, music; 5:30, reports; 7:30, bedtime stories; 8:10, concert. Eastern.

WGV, New Orleans, La. Interstate Elec. Co. 485 also.

WGY, Schenectady, N. Y. 400 and 485 only. 1,000 mi. General Elec. Co. Daily ex Sun. 11:55 am, 12:30 pm, 6, 10, reports, time, sports. Mon, Tues, Thur, Fri, 2-2:30 pm, 7:45, concert. Fri, 10:30 pm, special. Sun, 10:30 am, 4:30 pm, church service. Eastern.

WHA, Madieon, Wis. 485 also. 600 mi. Univ. of Wie. Daily ex Sun, 12:30-1 pm, weather, markets. Tues, Thure, Fri, Sat, 12-1 pm, weather, markets, time, Tues, 8-9 pm, concert. Fri, 8-9:15 pm, news, concert. Sat, 1-1:20 pm, instruction. Central.

WHAA, Iowa City, Ia. 200 mi. State Univ. of Ia. Daily ex Sun, 8-8:30 pm, lecture, concert, sports, news. Sun, 10:45-12 am, church service. Central.

WHAB, Galveston, Tex. 300, 485, 600 also. 500 mi. Clark W. Thompson (Fellman'e Dry Goods Co.) Daily ex Sun, 9:45-10:15 am, 3 pm, 5 pm, reports, music, news. Mon, Wed, Fri, 8 pm, entertainment. Sun, 10 am, church service. Central.

WHAC, Waterloo, Ia. 150 mi. Cole Bros. Elec. Co. Daily ex Sun, 6:15 pm, news, eports. Mon, Wed, Fri, 9:30 pm, concert. Central.

WHAD, Milwaukee, Wie. 485 also. 100 mi. Marquette Univ. Daily ex Sun, 10:58 am, time; 11:20 weather. Wed, 7:30-8:30 pm, music, entertainment. Central.

WHAE, Sioux City, Ia. 200 mi. Automotive Elec. Service Co. Daily ex Sun, 12:30-5:30 pm, music, reports. Thur, 7:30 pm, music. Central.

WHAF, Pittsburgh, Pa. 200 mi. Radio Elec. Co. Daily ex Sun, 11:30-12 m, 3-3:30 pm, music, newe, Sun, 9-10, music. Eastern.

WHAG, Cincinnati, O. 100 mi. Univ. of Cincinnati.

WHAH, Joplin, Mo. John T. Griffin.

WHAI, Davenport, Ia. 30 mi. Radio Equip. & Mfg. Co. Daily ex Sat. and Sun, 2-2:30 pm. 4:30-5:30. 10-11, Sat. 10-11 am. 2-2:30 pm, 5-5:30, 11-11:30. Central.

WHAJ, Bluefield, W. Va., Bluefield Daily Telegraph and E. K. Kitts.

WHAK, Clarksburg, W. Va. Roberts Hdwe. Co. 50 mi. No definite schedule.

WHAL, Lansing, Mich. 100 mi. Lansing Capitol Newe. Daily ex Sun, 9:15-9:45 am, 12:30-1 pm, 2:45-3:15, music, reports; 7:30-8:30 pm, concert. Sun, 2:30-3:30 pm, church service. Central.

WHAM, Rochester, N. Y. Univ. of Rochester.

WHAN, Wichita, Kans. Southwestern Radio Co.

WHAO, Savannah, Ga. 100 mi. Frederick A. Hill. Daily, 9:30-10 pm. Eastern.

WHAP, Decatur, Ill. 100 mi. Dewey L. Otta. No definite schedule.

WHAQ, Washington, D. C. 75 mi. Semmes Motor Co. Mon, 7-8 pm, lecture on automobile upkeep, music. Eastern.

WHAR, Atlantic City, N. J. Paramount Radio & Elec. Co.

WHAS, Louisville, Ky. 1,500 mi. Courier Journal and Louieville Times Co. Daily ex Sun, 4-5 pm, 7:30-9. Sun, 9:57-10:45 am, 4-5 pm, church service. Central.

WHAT, Yale, Okla. Yale Democrat (Yale Telephone Co.)

WHAV, Wilmington, Del. 200 mi. Wilmington Elec. Spec. Co. Daily ex Sun, 12-1 pm, music. Mon, Wed, Fri, 6-8 pm, concert. Tues, Thur, Sat, 6-7 pm, music. Eastern.

WHAW, Tampa, Fla. 50 mi. Pierce Elec. Co. Daily ex Sat, Sun, 12-1 pm, 4-5, music, agriograms. Sat, 12-1 pm, 8-10, music entertainment. Eastern.

WHAY Huntington, Ind. 75 mi. Huntington Press. Daily ex Sun, 12 m, 3 pm, music; 1:30 pm, 6, reports, sports. Mon, Wed, Sat, 8 pm, concert. Central.

WHAZ, Troy, N. Y. 400 only. 500 mi. Rensselaer Polytechnic Inst. Mon, 8:15-9:30 pm, music. Eastern.

WHB, Kansas City, Mo. 400 and 485 only. 1,000 mi. Sweeney Auto & Tractor School. Daily, 10 am, 3 pm, 5, weather. Daily ex Sun, 2 pm, ladies' hour; 7, bedtime stories. Tues, Thurs, Sun, 8-10 pm, concert. Central.

WHD, Morgantown, W. Va. 100 mi. W. Va. University. Daily, 4-6, 7-7:30, news etc. Eastern.

WHK, Cleveland, O. 300 mi. Warren R. Cox. Daily ex. Sun, 1:30-2 pm, 4-4:30, 6-6:30. Tues, Thur, Sun, 8-9:30 pm. Concert. Eastern.

WHN, Ridgewood, N. Y. Times Printing & Pub. Co.

WHU, Toledo, O. 360 and 485.

WHW, Eaet Lansing, Mich. 485 only. 150 mi. Stuart Wm. Seeley. Daily ex Sun, 11:30 am and 12:30 pm, weather and markets. Eastern.

WHX, Des Moines, Iowa. 50 mi. Iowa Radio Corp. Daily, 12:30-1 pm, 6-6:30. Sat, 3 pm, sports. Central.

WIAA, Waupaca, Wis. Waupaca Civic & Commerce Assn.

WIAB, Rockford, Ill. 50 mi. Joslyn Automobile Co. Tues, Fri, 8:30-9:30 pm, music. Central.

WIAC, Galveston, Tex. 485 also. 100 mi. Galveston Tribune. Tues, Thurs, Sat, 7 pm on, bedtime etory, evening prayer, concert. Central.

WIAD, Ocean City, N. J. 200 mi. Ocean City Yacht Club. Fri, Sat, Sun, 8-12 pm. Eastern.

WIAE, Vinton, Ia. 75 mi. Mre, Robt. E. Zimmerman, Tues, Thurs, Sat, 9 pm, music news. Wed, 8 pm, band concert. Sun, 2:30 pm, music. Central.

WIAF, New Orleans, La. 300 mi. Gustav A. De Cortin. Sun, 10-11 am, music lecture. Central.

WIAG, Birmingham, Ala. Mathews Elec. Supply Co.

WIAH, Newton, Ia. 200 mi. Continental Radio & Mfg. Co. Daily 12:30-1 pm, music, news. Mon, 7:30-8 pm. Central.

WIAI, Springfield, Mo. 100 mi. Heer Stores Co. Daily ex Sun, 10:30-11, reports, news. Tues, Thur, Sat, 7:30-8:30 pm music. Central.

WIAJ Neenah, Wisc. Fox River Valley Radio Supply Co.

WIAK, Omaha, Neb. 485 also. 300 mi. Daily Journal-Stockman. Daily ex Sun, 7:45 am, 9:10, 10:15, 12 m, 1:50 pm, 3:50 markete, weather. Central.

WIAN, Allentown, Pa. 100 mi. Chronicle-News. Schedule irregular.

WIAO, Milwaukee, Wis. 200 also. 100 mi. School of Engineering. Mon, Tues, Thur, Fri, 10:15-10:30 am; 11:30-11:45, news; 11:45-12:10 pm, lecture; 5-6 pm, newe; 7-7:15, music; 7:15-7:30, lecture. Central.

WIAP, Springfield, Mass. Radio Development Corp. 360.

WIAQ, Marion, Ind. Chronicle Pub. Co.

WIAR, Paducah, Ky. 150 mi. J. A. Rudy & Sons. Daily ex Sun, 11-12 am, markets, weather news, music; 4-5 pm same and sports; 7:30-9, concert, lectures, etc. Sun, 11-12 am, church service. Central.

WIAS, Burlingtun, Ia. 400 mi. Hawk-Eye Home Elec. Co. Tues, Thurs, 8-9 pm, concert. Central.

WIAT Tarkio, Mo. Leon T. Noel.

WIAU, Le Mars, Ia. Am. Trust & Savings Bank.

WIAV, Binghamton, N. Y. N. Y. Radio Lab.

WIAW, Saginaw, Mich. Saginaw Radio & Elec. Co.

WIAX, Lincoln, Neb. 200 mi. Capitol Radio Co. Thur, 8 pm, music, entertainment. Sun, 2:30 pm, 8, 9, church service. Central.

WIAY, Washington, D. C. 200 mi. Woodword & Lothrop. Daily ex Sun, 10:30-11:30 am, 2-3 pm, music. Sat, 8-10 pm, concert. Eastern.

WIAZ, Miami, Fla. Elec. Supply Sales Co.

WIK, McKeesport, Pa. 500 mi. K. & L. Elec. Co. Daily ex Sun. 6:30-7 pm. Tues, Thurs, 9:30-10:30 pm. Sun, 1:30-2:30 pm and 6:30-7 pm. Eastern.

WIL, Washington, D. C. 100 mi. Continental Elec. Supply Co. Daily 5:30-7 pm, music, entertainment. Eastern.

WIP, Philadelphia, Pa. 500 mi. Gimbel Bros. Daily ex Sun, 2:30-3:30 pm. Mon, Wed, Thur, 7-7:30 pm. Tues, Fri, Sat, 7-12 pm. Sun, am, pm, church service. Also 400.

WIZ, Cincinnati, O. 485 also. 200 mi. Cino Radio Mfg. Co. Daily ex Sun, 12 m, 3:30 pm, 7-8, reports, entertainment. Central.

WJAB, Lincoln, Nebr. 200 mi. American Radio Co. Mon, Wed, 8:30-9 pm. Central.

WJAC, Joplin, Mo., Redell Co., 360.

WJAD, Waco, Tex. 485 also. 500 mi. Jackson's Radio Engrng. Lab. Daily ex Sun, 12:30-1 pm, markets, news, music; 3:30-4, news, music; 6-6:15, sports; 8:45-9:45, concert, news. Sun, 11-12 am, church service; 3:30-4 pm, music; 6-6:15, eports; 8:45-9:45, music. Central.

WJAE, San Antonio, Tex. 500 mi. Texas Radio Syndicate (Evening News) Mon, 9:30-10:30 pm. Tues, Thurs, Sat, 7:30-8:30 pm, concert. Central.

WJAF, Muncie, Ind. 100 mi. Muncie Prees and Smith Elec. Co. Daily ex Sun. 3:30-4 pm. Mon, Wed, Fri, 7-8 pm. Sat, 6-7 pm. Central.

WJAG, Norfolk, Neb. 485 also. 150 mi. Norfolk Daily News. Daily ex Sun, 10:30 am, 12:15 pm, 3:30, 5:30, reports. Central.

WJAH, Rockford, Ill. Central Park Amusement Co.

WJAJ, Dayton, O. Y. M. C. A.

WJAK, Stockdale, O. 485 also. 250 mi. White Radio Lab. Daily ex Sun, 10:30-10:50 am, music; 11:05-11:20, reports, news; 6-6:30, music, news. Wed, 8-9 pm, concert. Sun, 2-2:45 pm, church service. Central.

WJAL, Portland, Me. Victor Radio Corp.

WJAM, Cedar Rapide, Ia. 100 mi. Evening Gazette. Daily, 7-8 pm, musical program. Central.

WJAN, Peoria, Ill. 300 mi. Peoria Star and Peoria Radio Sales Co. Daily ex Sun, 11:30 am, markets, weather; 1:30 pm, closing markets, agriograms, bond news; 6:15, sports. Tues, Thurs, Sat, 9:15-9:45 pm, concert. Central.

WJAP, Duluth, Minn. 200 mi. Kelley Duluth Co. Mon, Thur, 8-9:30 pm, music. Sun, 11-12 m, pipe organ, 12-1 pm, church service.

WJAQ, Topeka, Kans. Capper Publications.

WJAR, Providence, R. I. The Outlet Co., J. Samuels & Bro.

WJAS, Pittsburgh, Pa. 150 mi. Pittsburgh Radio Supply House (Pittsburgh Leader). Daily ex Sun, 11-11:30 am, 2:30-3 pm. Mon, Tues, Fri, 7-8 pm. Eastern.

WJAT, Marshall, Mo. 100 mi. Kelley-Vawter Jewelry Co. Daily ex Sun, 2-2:30 pm, 5:35-6, concert. Central.

WJAX, Cleveland, O. 485 also. 500 mi. Union Trust Co. Daily ex Sat pm, Sun, 9-9:45 am, 10-10:45, 2-2:45 pm, 3-3:45, music, financial reports, news, Eastern.

WJAZ, Chicago, Ill. Chicago Radio Lab.

WJD, Granville, O. 100 mi. Dennison University. Daily, 5-6 pm, concert, lecture. Central.

WJH, Washington, D. C. 100 mi. White & Boyer Co. Daily ex Sun, 1-2 pm, music. Tues, 7:45-10 pm, music. Eastern.

WJK, Toledo, O. 300 mi. Service Radio Equipment Co. Daily ex Sun, 3-4 pm, concert. Mon, Wed, Fri, 7:30-9 pm, concert, lecture, etc. Sun, 7:30-9 pm, church service, concert, Eaetern.

WJX, New York, N. Y. De Forest Radio Telephone & Telegraph Co.

WJZ, Newark, N. J. 485 also. 1,500 mi. Weetinghouse Elec. & Mfg. Co. Daily ex Sun, 15 minutes hourly from 9 am to 6 pm; 12-12:30 pm; 7-10:15 pm. Miscellaneous program of highly varied nature. Sun, 3-10:15 pm, music. Eastern.

WKAA, Cedar Rapide, Ia. 485 also. 200 mi. H. F. Paar. Daily ex Sun, 12:45 pm, reports; 5:30 reports, agriograme; 6-7, music. Thur, 11-12 pm, music. Sun, 4-5 pm, church service. Central.

WKAC, Lincoln, Neb. 400 mi. Star Pub. Co. Tues, Fri, 8-9:30 pm, concert, entertainment. Central.

WKAD, East Providence, R. I. Charlee Looff.

WKAF, Wichita Falls, Tex. W. S. Radio Supply Co.

WKAG, Louisville, Ky. Edwin T. Bruce, M. D.

WKAH, West Palm Beach, Fla. Planet Radio Co.

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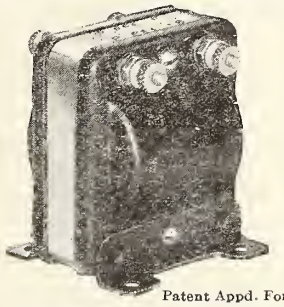

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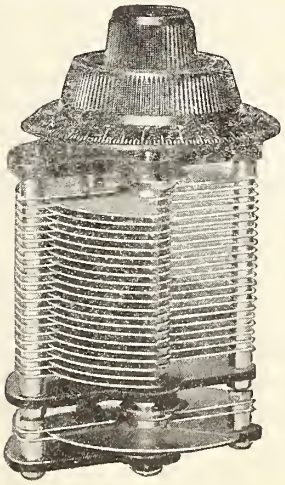

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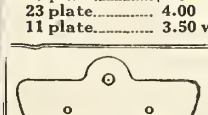

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Corrected List of U. S. Stations Alphabetically by Call Signals

WKAJ, Fargo, N. D. 150 mi. Fargo Plumbing & Heating Co. Daily ex Sun, 5-5:45 pm, concert, sports. Central.

WKAK, Okemah, Okla. Okfuskee County News.

WKAL, Orange, Tex. Gray & Gray.

WKAM, Hastings, Neb. Daily Tribune.

WKAN, Montgomery, Ala. 200 mi. Alahama Radio Mfg. Co. Daily ex Sun. 3:30 pm, 8:30, music, news. Eastern.

WKAP, Cranston, R. 1., Dutee W. Flint.

WKAQ, San Juan, Porto Rico. Radio Corp. of Porto Rico.

WKAR, East Lansing, Mich. Mich. Agrl. College.

WKAS, Springfield, Mo. 100 mi. L. E. Lines Music Co. Daily ex Sun, 6:30-7 pm, sports. Mon, Fri, Sat, 8-9:15 pm, music. Central.

WKAT, Frankfort, Ind. Morning Times. 360 and 485.

WKAV, Laconia, N. H. Laconia Radio Club.

WKAW, Beloit, Wis. 100 mi. Turner Cycle Co. Daily 12-12:15 pm, 7-7:30, concert. Central.

WKAX, Bridgeport, Conn, 75 mi. Wm. A. Macfarlane.

WKAY, Gainesville, Ga. Brenau College.

WKAZ, Wilkes-Barre, Pa. 100 mi. Landau's Music Co. Sat, 8-12 pm, dance music. Sun, 11 am, 8 pm, church service. Eastern.

WKC, Baltimore, Md. 500 mi. Jos. M. Zamoiskl Co. Tues, Tburs, Sat, 7:30-9:30 pm. Eastern, daylight saving.

WKN, Memphis, Tenn. Riechman-Crosby Co.

WKY, Oklahoma City, Okla. 485 also. 500 mi. Oklahoma Radio Shop. (Daily Oklahoman.) Daily 12 m, weather; 7-7:30 pm, sports, specials; 8:30-9:30, concert; 9, weather, news. Sun, 3:30-4:30 pm, concert. Central.

WL2, Fairfield, O. U. S. Army.

WLAC, Raleigh, N. C. N. C. State College.

WLAD, Hastings, Nebr. 150 mi. Arvanette Radio Supply Co.

WLAF, Lincoln, Neb. Johnson Radio Co.

WLAG, Minneapolis, Minn. 1,000 mi. Cutting & Walsh. Radio Corp. Daily ex Sun, 9:30-12 am, music, market reports; 1:30-3 pm, music, farm news, styles; 3:30-4:45, markets, music; 6-7:30, farm news, children's hour. Thur, Fri, Sat, 8-9:30 pm, concert. Sun, 4:30-5:30 pm, church services. Central.

WLAH, Syracuse, N. Y. Samuel Woodworth.

WLAJ, Waco, Tex. 485 also. 1,000 mi. Waco Elec. Supply Co. Daily ex Sun, 9:30 am, 10:30, 2:30 pm, music, reports. Tues, Thur, Sat, 7:45-8:45 pm, music. Sun, 3 pm, church service.

WLAK, Bellaws Falls, Vt. Vermont Farm Machine Co.

WLAL, Tulsa Radio Co. Tulsa, Okla.

WLAM, Springfield, O. 100 mi. Morrow Radio Co. Mon, Wed, Fri, 8-9:30 pm, dance music. Central

WLAN, Houlton, Me. Putnam Hdwe. Co.

WLAO, Scranton, Pa. 100 mi. 485 also. R. C. Ehrhardt and J. H. Jones. Mon, Wed, Fri, 7:15 pm, bedtime stories, reports, 8-9:45 pm, music. Sun, 7:30 pm, music; 8:30, church services; 9:15, music, Eastern.

WLAP, Louisville, Ky. W. V. Jordan.

WLAQ, Kalamazoo, Mich. 100 mi. A. E. Schilling. Daily, 10-12 pm, music. Central.

WLAR, Marshalltown, Ia. 50 mi. Melkel Music Co. No definite schedule.

WLAS, Hutchinson, Kan. Hutchinson Grain Radio Co.

WLAT, Burlington, Ia. Radio Specialty Co.

WLAV, Pensacola, Fla. 200 mi. Elec. Shop, Inc. Daily ex Sun, 8-9 pm, music, entertainment. Central.

WLAW, New York, N. Y. New York Police Dept.

WLAX, Greencastle, Ind. Greencastle Community Broadcasting Station. (Putnam Elec. Co.)

WLAY, Fairbanks, Alaska. Northern Commercial Co.

WLAZ, Warren, O. Hutton & Jones Elec. Co.

WLB, Minneapolis, Minn. Univ. of Minn. 100 mi. Daily ex Sun, 12-12:30 pm, 7:30-7:50. Central.

WLK, Indianapolis, Ind. 485 also. 500 mi. Hamilton Mfg. Co. Daily ex Sun, 11-11:30 am, 12-12:30 pm, 2-2:30, 3-3:30, 5-5:30, reports. Tues, Thur, 8:30-10 pm, concert. Sun, 2-4 pm, 8:30-10. Central.

WLW, Cincinnati, O. 485 also. 500 mi. Crosley Mfg. Co. Daily ex Sun, 10 am-3 pm, music, reports. Tues, Thur, Fri, 8-10:30 pm, music, news. Sun, 11 am, church service. Central.

WMA, Anderson, Ind. 25 mi. Arrow Radio Lab. Mon, Wed, Fri, 7:30-8:30 pm, concert, news, etc. Central.

WMAB, Oklahoma City, Okla. 500 mi. Radio Supply Co. Daily ex Sun. 9:30-10:30 pm, music. Fri, 11:30-12:30 pm. Central.

WMAC, Cazenovia, N. Y. 330, 250, 275 only. 500 mi. C. B. Meredith. No definite schedule.

WMAD, Atchinson County Mail, Rock Port, Mo.

WMAF, Dartmouth, Mass. Round Hills Radio Corp.

WMAG, Liberal, Kan. 75 mi. Tucker Elec. Co. Daily ex. Fri, Sun, 7:30-8:30 pm, music, news. Fri, 8-9 pm, concert. Central.

WMAH, Lincoln, Neb. 100 mi. General Supply Co. Daily ex Sun, 2:15 pm, music, news. Mon, Wed, Thur, 7:30 pm, music. Sun, 2:30, music, news. Central.

WMAJ, Kansas City, Mo. 485 also. 600 mi. Daily Drovers Telegram. Daily ex Sun, 8:15 am, 9:15, 10:15, 11:15, 1:15 pm, 2:30, weather, markets. Central.

WMAK, Lockport, N. Y. Norton Labs.

WMAL, Trenton, N. J. 100 mi. Trenton Hdwe. Co. Mon, Thur, 7:30-9 pm, music, lecture. Eastern.

WMAM, Beaumont, Tex. Beaumont Radio Equipment Co.

WMAN, Columbus, O. 50 mi. First Baptist Church. Sun, 10:30-12 m, 7:30-9 pm, church services. Central.

WMAP, Easton, Pa. Utility Battery Service.

WMAQ, Chicago, Ill. 1,500 mi. Chicago Daily News. Daily. 7-7:30 pm, 9:30-10. Central.

WMAR, Waterloo, Ia. Waterloo Elec. Supply Co.

WMAT, Duluth, Minn. Paramount Radio Corp.

WMAV, Auburn, Ala. Polytechnic Inst.

WMAW, Wahpeton, N. D. 50 mi. Wahpeton Elec. Co. Daily, 7-7:30 pm, music, sports, news. Central.

WMAU, Shreveport, La. La. State Fair Assn.

WMAX, Ann Arbor, Mich. K. & K. Radio Supply Co.

WMAY, St. Louis, Mo. Kingshighway, Presby. Church.

WMAZ, Macon, Ga. Mercer Univ.

WMB, Auburn, Me. Auburn Elec. Co.

WMC, Youngstown, O. 500 mi. Columbia Radio Co. Mon, Wed, Fri, Sat, 8:30-9:15 pm, concert, address, etc. Eastern.

WMH Cincinnati, O. 485 only. 500 mi. Precision Equipment Co. Daily ex Sun, 11 am, 4 pm, reports. Mon, Wed, Sat, 8:15 pm, entertainment. Central.

WMU, Washington, D. C. 100 mi. Doubleday-Hill Elec. Co. Daily, 4:30 pm, concert, sports. Thurs, 8-9, concert. Eastern.

WNAB, Bowling Green, Ky. Park City Daily News.

WNAC, Boston, Mass. 200 mi. Shepard Stores. Daily ex Sun, 4-5 pm, dance music. Mon, Tues, Thur, 10-11 pm, concert. Wed, Fri, Sat, 7-8 pm, 8-9, concert. Sun, 11-12 am, 6:30-8:30 pm, church service. Eastern.

WNAD, Norman, Okla. 200 mi. Okla. Radio Engineering Co. Daily ex Sun, 7:45-8:15 pm, news. Central.

WNAF, Enid, Okla. Enid Radio Dist. Co.

WNAG, Cresco, Ia. Rothert Radio and Electric Shop.

WNAH, Manhattan, Kan. Manhattan Radio Supply Co.

WNAJ, Chicago, Ill. Benson Co.

WNAK, Manhattan, Kas. Manhattan Radio Supply Co.

WNAL, Omaha, Neb. R. J. Rockwell.

WNAN, Syracuse, N. Y. Syracuse Radio Telephone Co.

WNAP, Springfield, O. Wittenberg College.

WNAQ, Charleston, S. C. Charleston Radio Electric Co.

WNAS, Austin, Tex. Radio Corp. (Austin Statesman).

WNAT, Phila., Pa. Lennig Bros. Co.

WNAV, Knoxville, Tenn. People's Tel. & Tel. Co.

WNAY, Baltimore, Md., Shipowners' Radio Service.

WNAX, Yankton, S. D. Dakota Radio Apparatus Co.

WNAW, Fortress Monroe, Va., Henry Kunzmann.

WNJ, Albany, N. Y. 60 mi. Shotton Radio Mfg. Co., Inc. Daily ex Sun, 10-10:15 am, market reports. Wed, 8:15-10 pm, concert. Eastern.

WNO, Jersey City, N. J. Wireless Telephone Co. of Hudson Co., N. J.

WOAA, Ardmore, Okla. Dr. Walter Hardy.

WOAC, Lima, O. Maus Radio Co.

WOAE, Fremont, Nebr. Medland College.

WOAF, Tyler, Tex. Tyler Commercial College.

WOAI, San Antonio, Tex. 485 also. 1,000 mi. Southern Equip. Co. Daily ex Sun, 10:30 am, 12:15 pm, 3, 6, news, markets. Wed, 7:30-8:30 pm, concert. Sun, 7-8:30 pm, concert. Central.

WOAJ, Parsons Kans. Erving's Electrical Co.

WOAV, Erie, Pa. Penna. Nat'l Guard.

WOC, Davenport, Ia. 400 and 485 only. 500 mi. Palmer School of Chiropractic. Daily ex Sun, 10:55 am, time; 11, weather; 12 m, chimes; 1:30 pm, markets; 3:30, talk; 5:45, chimes; 6:30, sports; 7, concert. Sun, 9 am, chimes; 1 pm, 6, concert; 7, church service; 8, concert. Central.

WOE, Akron, Ohio. 100 mi. Buckeye Radio Service Co. Mon, Wed, Fri, 7-8:15 pm, music, agriograms, sports. Sat, 4-4:30 pm, music, sports. Eastern.

WOH, Indianapolis, Ind. 1,000 mi. Hatfield Elec. Co. (Indianapolis Star.) Daily ex Sun, 10-11 am, music; 1015, financial, markets; 1-2 pm, music; 1:20, markets; 4-5 pm, music; 4-15, police notes; 4:50, sports. Mon, Wed, Sat, 8:30-10 pm, concert. Central.

WOI, Ames, Ia. 485 also. 200 mi. Iowa State College. Daily ex Sun, 9:30 am, 12:45 pm, 9:30, music, weather. Central.

WOK, Pine Bluff, Ark. 485 also. 500 mi. Ark. Light & Power Co. Tues, Fri. 8-9:30 pm, concert. Sun, 10-12 am, 7-9 pm, church service. Central.

WOO, Philadelphia, Pa. 400 and 485 only. 500 mi. John Wanamaker.

WOQ, Kansas City, Mo. 485 also. 1,000 mi. Western Radio Co. Mon, Tues, Wed, Thur, 9:45 am, 10:55, 11:30, 12:30 pm, 2, 7:30, time signals, reports, etc.; Fri, 1:15 pm, sacred service. Sat, 8 pm, concert. Sun, 7 pm, concert.

WOR, Newark, N. J. 400 only. 150 mi. L. Bamberger & Co. Daily ex Sun, 20 minutes on half hour from 10:30 am to 6:30 pm, miscellaneous. Eastern, daylight saving.

WOS, Jefferson City, Mo. 485 also. 1,500 mi. Mo. State Marketing Bureau. Daily ex Sun, 9:30 am, 11:30, 2 pm, weather, markets. Mon, Wed, Fri, 5 pm, markets, 8-9 pm, concert. Central.

WOV, Omaha, Neb. R. B. Howell.

WOU, Omaha, Neb. Metropolitan Utilities.

WOZ, Richmond, Ind. 485 also. 300 mi. Palladium Printing Co. Daily ex Sun, 12-12:25 pm, 4-5, 6:30-7, music, markets. Central.

WPA, Fort Worth, Tex. 485 also. 500 mi. Fort Worth Record. Daily ex Sun, 11:30 am, 2:30-3 pm, 6-6:15, 7:15-7:30; 9-9:30, Sun, 3-3:30 pm, 6:30. Central.

WPAA, Wahoo, Neb. Anderson & Webster Elec. Co.

WPAB, State College, Pa.

WPAD, Chicago, Ill. Wieboldt & Co.

WPAF, Council Bluffs, Ia. Peterson's Radio Co.

WPAL, Columbus, O. Superior Radio & Tel. Equip Co.

WPAM, Topeka, Kans. Awerbach & Guettel.

WPAN, Houston, Tex. 300, 600 also. 50 mi. Levy Bros. Dry Goods Co. Daily ex Sun, 10:30-11 am, fashion talks, beauty hints. Central.

WPE, Kansas City, Mo. 300 mi. Central Radio Co. Mon, Fri, Sun, 7:45 pm, concert. Sun, 8:15 pm, sermonette. Daily, afternoon, sports, scores. Central.

WPG, New Lebanon, Ohio. 485 also. 500 mi. Nushawa Poultry Farm. Daily ex Sun, 8-9 am, 3-4 pm, music, markets. Tues, Thur, Sat, 7:30-9:45 pm, music. Central.

WPI. Clearfield, Pa. Elec. Supply Co.

WPJ, Philadelphia, Pa. 30 mi. St. Joseph's College. Daily ex Sun, 2:30 pm, 8:30, sports, news. Sun, 10:45-12 noon, 7:45-8:30 pm, church service. Eastern.

WPM, Washington, D. C. 200 mi. Thos. J. Williams, Inc. (Washington Daily News.) Daily ex Sun, 12:30 pm, news. Mon, 8 pm, concert. Eastern.

WPO, Memphis, Tenn. 100 mi. United Equip. Co. Daily, 7:15-8:15 pm, music. Central.

WQAP, Lincoln, Nebr. Am. Radio Co.

WQAQ, Abilene, Tex. West Tex. Radio Co.

WQX, Chicago, Ill. Riverview Park, Walter A. Kuehl.

WRAU, Amarillo, Tex Daily News.

WRAY, Scranton, Pa. Radio Sales Corp.

WRK, Hamilton, O. 1,000 mi. Doron Bros. Elec Co. Tues, Thur, 9-10:30 pm, music, lecture. Sun, 10:30 am, church service. Central.

WRL, Schenectady, N. Y. 800 mi. Union College. Sun, 7:30 pm, sacred concerts, speeches, etc. Irregular, miscellaneous weekday program. Eastern.

WRM, Urbana, Ill. 400 also. 300 mi. Univ of Ill. Mon, Thur, 8:30-8:50 pm, 9-9:30, news, talks, music. Central.

WRP, Camden, N. J. 250 mi. Federal Inst. of Radio Telg. Daily ex Sat, Sun, 10-10:45 pm, music, news, agriograms. Eastern.

WRR, Dallas, Tex. 485 also. 200 mi. City of Dallas. Daily ex Sun, 12-12:30 pm, weather; 3-3:30, sports, markets, news; 7-7:15, police news; 8:30-9, music. Sun, 11 am, church service; 7-8 pm, police news, church service. Central.

WRW, Tarrytown, N. Y. 500 mi. Koenig Bros. Daily ex Sun, 6:15-7 pm, 10:30-12. Mon, Wed, Sat, 5-5:30 pm. Tues, Fri, 2:30-3 pm. Sun, 1-3 pm. Eastern.

WSAS, Lincoln, Nebr. State of Nebr.

WSAV, Houston, Tex. 300 mi. C. W. Vick Radio Const'n Co. Tues, Fri, 8-10 pm, concert, entertainment. Central.

WSB, Atlanta, Ga. 400 and 485 only. 1,500 mi. Atlanta Journal. Daily ex Sun, 12-1 pm, music; 2:30, reports; 4-4:45 pm, music, reports; 5-6 pm, 7-8, 10:45-12, music. Sun, 10:45 am, 5-6 pm, 7:30-9, church services. Central.

WSL, Utica, N. Y. 500 mi. J. & M. Elec. Co. Daily ex Sat, Sun, 11-11:30 am, 2-2:30 pm, 3-3:30, 4-4:30, 5-5:30, music, news. Mon, Wed, 8-9 pm. Sat, 11-11:30 am, 5-6 pm, 8-9. Sun, 10:30-12 m, 7:30-9 pm. Eastern.

WSN, Norfolk, Va. 100 mi. Shipowners' Radio Service Inc. Mon, Wed, Sat, 8:15-9:30 pm, concert. Eastern.

WSV, Little Rock, Ark. L. M. Hunter & G. L. Carrington.

WSX, Erie, Pa. 75 mi. Erie Radio Co. Tues, Thurs, Sat, 10-10:55 pm, news, concert, lecture. Sun, 12:15-1:30 pm, sermon. Eastern.

WSY, Birmingham, Ala. 500 mi. Alabama Power Co. Mon, Wed, Fri, 2:30 pm, ex Sun, and 8 pm daily, reports, concert. Sun, 8-9 pm, church service. 485 also. Central.

WTAW, College Station, Tex. Agricultural and Mechanical College of Tex.

WTG, Manhattan, Kan. 485 only. 75 mi. Kan. State Agrl. College. Daily ex Sun, 9:55 am, weather (code). Central.

WTK, Paris, Tex. 300 mi. Paris Radio Elec. Co. Daily ex Sun, 10 am to 5 pm, 7-11 pm, miscellaneous. Sun, 11 am to 8 pm. Central.

WTP, Bay City, Mich. 75 mi. Ra-Do Corp. Mon, Wed, Fri, 1:30-2 pm, reports, news; 6:30-7:30 pm, concert. Central.

WVP, New York, N. Y. Signal Corps, U. S. Army.

WWAC, Waco, Tex. Sanger Bros.

WWAX, Laredo, Tex. Werman Bros.

WWB, Canton, O. Daily News Printing Co.

WWI, Dearborn, Mich. 200 mi. Ford Motor Co. Wed, 10-11 pm, music, lectures. Eastern.

WWJ, Detroit, Mich. 400 and 485 only. 1,500 mi. Evening News. Daily ex Sun, 9:30-9:40 am, household hints; 9:40-10:25, entertainment; 10:25-10:30 am, 11:55-12 m, 12:05-12:45 pm, reports, music; 3-3:30, music; 3:30-3:35, reports; 3:35-4:15, markets; 5-6, sports; 7:30-10, entertainment. Sun, November 11 and every other week, 11 am, 4 pm, church services. Sun, fill in weeks, 2 pm, 7:30, church services, special. Eastern.

WWL, New Orleans, La. Loyola Univ.

WWX, Washington, D. C. 1,160 only. 600 mi. Post Office Dept. Daily ex Sun, 10 am, weather; 10:30, markets; 5 pm, 7:30, 8, markets; 9:50, weather. Eastern.

WWZ, New York City. 200 mi. John Wanamaker. Daily ex Sun, 1:15-2:15 pm. Tues, Fri, 7:30-8:30 pm. Eastern.

IXAD, Pawtucket, R. I. Standard Radio & Elec. Co.

2XAI, Newark, N. J. Westinghouse Elec. & Mfg. Co.

2XI, New York City. A. T. & T. Co. Test call.

2XJ, Deal Beach, N. J. Amer. Tel. & Telg. Co.

3XW, Parkesburgh, Pa. 378 only. 400 mi. Horace A. Beale, Jr. No definite schedule. Test station.

3YN, Washington, D. C. 100 mi. Nat'l Radio Inst. Daily ex Sun, 6:30-7:30 code practice, lecture. Eastern.

9ARU, Louisville, Ky. 200 only. 200 mi. Darrell A. Downard. Mon, Wed, 8 pm, police news, concert. Central.

Radio Routes

Official reports of new lines of radio communication between Italy and the United States, following the recent suspension of direct radio communication and pending the completion of a new high-power station at Rome, have been made to the Government here by Commercial Attache MacLean at Rome.

Radio traffic from Italy for North and South America is now being handled via the high-power stations of Germany, France and England, according to statements of the Ministry of Posts and Telegraphs at Rome. Full-rate and deferred messages and press telegrams may be sent via Nauen Transradio and Radio-France, and full rate and deferred messages via London Marconi.

Messages sent via Nauen are transmitted by radio from Rome and relayed at Nauen. Traffic handled by France or England is sent by land wires from Italy and thence by radio. Messages via France or Germany will carry a rate of 20 centimes gold less than the cable rate, in the case of full-rate telegrams. Via London, the same messages would be ten centimes gold less than the cable rate. Deferred dispatches will be charged half the above rates. Press reports may be sent via France or Germany at the same rate as deferred messages, but not handled via London.

New Stations in 9th District

Licenses issued during month ending October 30, 1922

Call signal	Station operated and controlled by—	Location of station.
9CYC	James W. Pattie	505 N. Third St., Clear Lake, Iowa
9CYD	Laddie J. Smach	2530 S. Ridgeland Ave., Berwyn, Ill.
9CYE	Stuart W. Daniel	3812 Garfield Ave., Minneapolis, Minn.
9CYF	Willard W. Crittenton	1919 Lunt Ave., Chicago, Ill.
9CYG	Carl F. Myers	3637 S. Benton St., Kansas City, Mo.
9CYH	Marshall W. Rife	Meriden, Ill.
9CYI	Culver W. Lamar	805 S. Marion St., Carbondale, Ill.
9CYJ	Norman L. Wise	2805 Northwestern Ave., Indianapolis, Ind.
9CYK	Russell A. Cline	207 S. Buchanan St., Maryville, Mo.
9CYL	Carl R. Griesbacher	Route No. 1, Box 34, Dousman, Wisc.
9CYM	Lester H. Smyth	3605 Balsam Ave., Indianapolis, Ind.
9CYN	Arthur Ralph Bryant	Physics Bldg., Grinnell, Iowa
9CYO	Frank W. O'Herron	934 N. 5th St., Terre Haute, Ind.
9CYP	John S. Brown	1017 Bluff St., Fulton, Mo.
9CYQ	D. James Angus	310 Illinois St., Indianapolis, Ind.
9CYR	F. H. Eddy	Main St., Slayton, Minn.
9CYS	Frank Little	Auburn, Ill.
9CYT	Stewart M. Scott	6026a Washington St., St. Louis, Mo.
9CYU	Z. Paul Clement	105 Delaware St., Mason City, Iowa
9CYV	John R. Robertson	616 W. Eighth St., Coffeyville, Kans.
9CYW	Walter McGuire and Fred D. Rowe	313 W. Third St., Cambridge City, Ind.
9CYX	Cary P. Butcher	706-15th St. (P. O. Box 93), Golden, Colo.
9CYY	Robert G. Bentzinger	1605 Arlington Ave., St. Louis, Mo.
9CYZ	Harold McCollom	513 N. 8th St., Winterset, Iowa
9CZA	Arthur N. Gunderson	2035 Nebraska Ave., Chicago, Ill.
9CZB	Calvin A. Wolfe	159 N. 10th St., Noblesville, Ind.
9CZC	Bern McElwain	Blencoe, Iowa
9CZD	W. G. Shirkey	Richmond, Ind.
9CZE	Joseph N. Dohr	415 State St., Appleton, Wisc.
9CZF	William T. Gill	490 Lafayette Place, Milwaukee, Wisc.
9CZG	Arnold L. Wolfe	365 S. Pearl St., Denver, Colo.
9CZH	Crete Battery Service	35 S. Maine St., Crete, Ill.
9CZI	Glenn Keller	501 S. Main St., Chaffee, Mo.
9CZJ	Carl A. Neureuther	R. F. D. No. 1, Spring Valley, Ill.
9CZK	Joe D. Willoughby	757 Cook St., Denver, Colo.
9CZL	R. B. Horrall	225 Elliott St., Olney, Ill.
9CZM	Charles W. Lewis, Jr.	323 Clara Ave., St. Louis, Mo.
9CZN	Harvey E. Roberts	628 Clark Ave., Webster Groves, Mo.
9CZO	Bertil A. Beck	Alta, Iowa
9CZP	Radio Panel Shop	312 W. 14th St., Junction City, Kans.
9CZQ	Alfred F. Christianson	University Law Bldg., Valparaiso, Ind.
9CZR	John F. Perfetti	613 Adeline St., So. Hibbing, Minn.
9CZS	Indiana Radio Engineering Co.	372 W. 30th St., Indianapolis, Ind.
9CZT	Charles N. Cutler	311 W. Johnson St., Sullivan, Ind.
9CZU	Earl L. Frease	919 Milliam Ave. (P. O. Box 74), Ravenna, Neb.
9CZV	Julian F. Oberg	7350 Union Ave., Chicago, Ill.
9CZW	Bert L. Brown	26 Alexandria Pike, Newport, Ky.
9CZX	Roy F. Graham	5343 Theodosia Ave., St. Louis, Mo.
9CZY	Theodore H. Schaefer	Franklin St., Slinger, Wisc.
9CZZ	Alta M. Blackburn	672 Van Buren St., Apt. No. 9, Milwaukee, Wis.
9EAA	Harry Needham	R. F. D., No. 6, Virginia, Ill.
9EAB	Paul Jensen	4931 Hamlin Ave., Chicago, Ill.
9EAC	Joe Clark	326 N. Main St., Carrollton, Ill.
9EAD	Dudley Andrews	1721 Somerset Ave., Indianapolis, Ind.
9EAE	Ronald S. McEwen	619 Tillitson St., Trinidad, Colo.
9EAF	C. L. Giesler	5055 Geraldine St., St. Louis, Mo.
9EAG	Lawrence Jacobsen	c-o Western Military Academy, Alton, Ill.
9EAH	Richard C. Wells	424 E. 63d St., Chicago, Ill.
9EAI	Chester C. Grey	610 S. 10th St., Cedar Rapids, Iowa
9EAJ	Edgar R. Fawcett	4557 St. Louis Ave., St. Louis, Mo.
9EAK	Ernest M. Helmdoerfer	147 N. Second St., Denver, Colo.
9EAL	Vernon H. Wallace	1017 Lee St., Ottumwa, Iowa
9EAM	Edwin M. Nissen	2544 Washington St., Denver, Colo.
9EAN	LaVerne Wilson	2144 Washington St., Granite City, Ill.
9EAO	J. Norvel Sayler	Hopkins, Mo.
9EAP	Maurice M. Wold	918 East 36th St., Minneapolis, Minn.
9EAQ	Joe-John's Radio Co.	216 S. Main St., Huntsville, Mo.
9EAR	Richard Schweiger	709 S. Spring St., Beaver Dam, Wisc.
9EAS	Oliver P. Rohinson	Calumet Harbor Lighthouse, 9237 Houston St., Chicago, Ill.
9EAT	Chester E. Doerr	5152 N. Market St., St. Louis, Mo.
9EAU	Independent School District No. 40	Third and Hemlock Sts., Chisholm, Minn.
9EAV	Otto A. Buder	611 Commercial Ave., Cairo, Ill.
9EAW	Joseph E. Harlan	335 Askew St., S., Kansas City, Mo.
9EAX	Thomas M. Breen	2421 S. First Ave., Minneapolis, Minn.
9EAY	Hilary J. Schenk	417 Seventh St., Calumet, Mich.
9EAZ	Vermilion High School	Church St., Vermilion, S. Dak.
	CALLS REISSUED	
9FV	Allen T. Law	3439 Grove St., Denver, Colo.
9HZ	George A. Sim, Jr.	5527 Lowe Ave., Chicago, Ill.
9VY	Dale Roger Clemons	820 Lincoln Ave., Valparaiso, Ind.
9ATO	Edwin A. Cary	1290 Kinnickinnic Ave., Milwaukee, Wisc.
9ATR	Hal. P. Rea	R. F. D. No. 4, Carrollton, Mo.
9AUI	Arthur W. Peters	219 Rockford St., N., Rockford, Ill.
9AUS	Russell Martin	307 Cherry St., Mt. Carmel, Ill.
9DDZ	John Henry Grady	Rolla, Mo.
9DIH	Ralph A. Dicksen	7318 Kingston Ave., Chicago, Ill.
9DNT	Oscar Larson	7400 Coles Ave., Chicago, Ill.
9DRV	Jack Shafer	713 South Dakota Ave., Sioux Falls, S. Dak.
	CALLS CANCELLED	
9AB	Thordarson Elec. Mfg. Co.	501 S. Jefferson St., Chicago, Ill.
9BM	Howard I. Crawford	515 Fourth St., Wausau, Wisc.
9BY	Electric Machine Co.	329 W. Ohio St., Indianapolis, Ind.
9SG	Coe College	1st Ave. and 12th St., Cedar Rapids, Iowa
9VY	Claude P. Middleton	815 N. 12th St. (12th St.), DeKalb, Ill.
9ALS	Raymond L. Smith	5527 S. Lowe Ave., Chicago, Ill.
9APE	Lowell S. Orth	1412 N. Adams St., Mason City, Iowa
9ATO	Arthur B. Bryant	Hotel Clarke, Hastings, Nebr.
9ATR	Carl R. Griesbacher	R. No. 1, Box 34, Dousman, Wisc.
9AUI	Frank Little	N. Ninth St., Auburn, Ill.
9AUS	Robert A. Jolliff	3051 N. 18th St., Kansas City, Kans.
9BGJ	Thomas A. Maxwell, Jr.	644 North 24th St., Lincoln, Nebr.
9CIX	Robert W. Carel	4630 Zuni St., Denver, Colo.
9DDD	Ward H. Ingersoll	Buffalo, Minn.
9DDZ	Robert B. Horrall	225 Elliott St., Olney, Ill.

(Continued on next page.)

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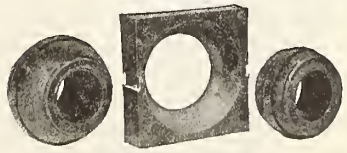
Don't let others beat you to the big money. **Start now** and within a few weeks' time I will train you at home, at an amazingly low cost, to become a RADIO EXPERT. Write for **"Radio Facts"** sent **free** without obligation.

A. G. MOHAUPT, Electrical Engineer
American Electrical Association
Dept. E9, 4511 Ravenswood Ave. Chicago.

WRITE TODAY

Artistic Variometer Parts

Wholesale Only



Variocouplers,
Rotors, Winding Forms, Stators,
in Genuine Mahogany.

Quick Deliveries. Write for prices.

Artistic Wood Turning Works

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RADIO MAILING LISTS

10,975	Radio Dealers covering U. S. by states per M.	$ 7.50
1,320	Radio Mfgrs. covering U. S. by states per list	12.50
1,325	Radio Supply Jobbers covering U. S. by States per list	12.50
260	Radio Stations per list	4.00
257	Mfgrs. who maks and assembls complete Radio ssts per list	4.00
25,000	Radio Amatsurs & Managers of Radio Stations per M	7.50
3,000	Radio Amateurs & Managers of Radio Stations in Canada per M.	7.50
20	Radio Manufacturers in Canada per list.	1.50
87	Radio Supply Jobbers in Canada per list	2.50
131	Retail Radio Dealers in Canada per list	3.00
125	Mfgrs. & Jobbers & Retail Dealers in England per list	4.00

Ready to send on receipt of remittance.

TRADE CIRCULAR ADDRESSING CO.
166 W. Adams Street, Chicago.

A Homemade Battery Charger

(Continued from page 4.)

parallel as shown will allow more current to flow. The direct current is taken off at the junction between the jars as shown. To recharge the battery, connect the positive direct current terminal to the positive terminal on the battery and the negative direct current terminal to the negative terminal of the battery.

The action of this rectifier is based upon the principle that the current will not enter the solution through the aluminum plate. It will enter the solution from the lead plate and flow out through the aluminum, however. Let us for example say that the circuit shown in Figure 2 is connected to a source of alternating current supply. If the first impulse comes in on the side of the circuit in which the lamps are placed, the current will not enter the aluminum plate in the jar on the left side, but will enter the lead plate on the right side, flowing out of the aluminum plate. It cannot enter the cell below it, because of the aluminum plate, but will flow out over the direct current terminal, through the battery and back on the negative direct current terminal, through the lower cell on the left side to the other side of the alternating current.

The next impulse is in the reverse direction and comes to the lower set of cells. The aluminum plate in the left hand cell prevents the current entering, so it takes the path through the right hand cell, coming out of the direct current positive wire again, through the battery, back into the negative direct current terminal, through the upper left hand cell, to the other side of the alternating current line. Thus it will be seen that the direct current terminal on the right side of the drawing will always be positive, no matter which way the alternating current flows.

This rectifier will give very good service and will put a good charge in the battery in twenty-four hours. A small hole should be drilled in the wooden tops to allow any gas to escape. As it will be necessary to "form" the plates before the rectifier will function properly, the two direct current posts should be connected together for about ten hours while the alternating current is on, so that perfect rectification will take place when the battery is connected in the circuit. After the plates are once formed, then the battery may be connected on the terminals at any time. A more efficient method is to use a toy transformer, connecting the primary directly to the alternating current mains and the secondary directly to the rectifier. The voltage of these toy transformers is usually adjustable, so that the rate of charging may be regulated by the controlling switch on the secondary of the transformer. This method will charge the battery faster, and is much more efficient.

New Stations in 9th District

(Continued from page 27.)

9DIH	Gerald H. Bockus	1409 Como Ave., S. E., Minneapolis, Minn.
9DNT	Leland S. Jett	434 Laurel Ave., St. Paul, Minn.
9DOR	Oliver P. Robinson	Calumet and Harbor Lighthouse, Chicago, Ill.
9DRV	Russell Martin	307 Cherry St., Mt. Carmel, Ill.
9DTB	Harry Needham	R. F. D. No. 6, Virginia, Ill.
9DVM	John Henry Grady	Westgate Hotel, St. Louis, Mo.
9YAP	St. Ambrose College	600 W. Locust St., Davenport, Iowa
9ZAE	Palladium Printing Co.	19 North 9th St., Richmond, Ind.
	CHANGES IN ADDRESS	
91C	Albert E. Jeffrey	1159 E. 54th Place, Chicago, Ill.
9TD	Hobart D. Ashlock	729 S. 10th St., Noblesville, Ind.
9BBS	Anton Mix	910 Adams St., Waukegan, Ill.
9DX	Jay F. Carpenter	1124 University Ave., Denver, Colo.
9QE	Ivan J. Bulock	718 East Second St., Fairmont, Minn.
9EX	Julius Abercrombie	819 N. 23d St., St. Joseph, Mo.
9DVY	Marvin Eichorst	858 N. 15th St., Manitowoc, Wisc.
9SL	Jay Nagle Edmondson	Parsons College, Fairfield, Iowa
9APZ	Everett Vogel	6 Beech Ave., South Gate, Ky.
9UL	Carl Sherman Tunwall	11th and 1st Ave., N., Ft. Dodge, Iowa
9BCA	John G. Kuesport	602 E. Haney Ave., South Bend, Ind.
9AFT	Eugene W. Applebaum	910 Addison St., Chicago, Ill.
9BWP	Edward J. Posselt	5317 W. 25th St., Cicero, Ill.
9KE	Edwin A. Beane	912 E. 61st St., Chicago, Ill.
9ON	C. Frank Smiley	7834 Lagoon Ave., Chicago, Ill.
9ADN	Laurence W. Franklin	1123 South St., Lafayette, Ind.
9DFR	Merritt Clair Haigh	14th and Pleasant View Drive, Des Moines, Ia.
9AEK	Harmon B. Deal	Iowa State College, Ames, Iowa
9AMW	Howard Hill Smith	603 E. Springfield Ave., Champaign, Ill.
9BEB	Linton H. Flocken	612 W. Illinois St., Urbana, Ill.

Panama Fans Grieve

Homesick amateurs in the Canal Zone and in Panama are protesting against an order of the U. S. Navy Department, forbidding them to operate their private broadcasting stations. Panama has granted all rights of wireless communication in that country to the United States and therefore the navy's jurisdiction is absolute. Important strategic conditions affecting the security of the canal are thought to have influenced the Navy Department in shutting off the joys of amateur experimentation.

The Panama canal is defended by a circle of big coast defense guns, some of them mounted on the mainland and some on small islands lying off the ends of the canal. These guns are considered a sound defense against a fleet attack under ordinary conditions. With a great number of wireless stations in and around the isthmus it might be possible in the confusion and jamming which usually occurs in time of battle, for land radio stations to report the observation of enemy fire and direct it upon the American guns.

To amateurs in the canal strip, however, the restrictions seem oppressive and hundreds of protests are said to have been received by the government authorities. Associations of amateurs have even offered to pay all cost of the government supervision of their stations if they could be allowed to operate.

Receiving Equipment

(Continued from page 7.)

fect, that simultaneous adjustment of anode inductance be made with adjustment of wave length.

The design of the oscillating circuit tuning elements of a receiver is largely determined by the range of wave length desired and the regenerative scheme employed, if any, the inductance or capacity elements alone may be variable, or, to obtain a greater range of wave length adjustment, they may both be variable.

When the inductive coupling for regeneration is employed, it is usually desirable that at least the inductance element in the oscillating circuit be varied for adjustment of resonant wave length, as by this means the proper coupling between the resonant circuit inductance and the feed-back coupling coil for constant regeneration at various wave lengths can be obtained.

The foregoing remarks mainly cover questions of design affecting the tuning elements of the receiver, and on the general assumption that a three-element vacuum tube receiving system of the requisite sensitivity is employed.

The problems which may be presented for future development will be influenced largely by the condition imposed on the operation of the transmitting stations. With the transmitters grouped in one band of wave length, the possibilities of improvement are very remote. With the separation of transmitting waves, the ease of solution of the interference problem increases with the extent of this separation. The logical solution would appear to be a separation which would correspond to the possibilities of available receiving apparatus, and it is probable that, as the number of transmitters continues to increase, with a corresponding reduction of wave separation, the development of receiving apparatus will keep pace with the increasing exactitude of requirements.

Plan to Popularize Radio

FARMERS generally and residents in small towns throughout the country still hesitate to buy radio receiving outfits because crystal sets do not pick up the nearest broadcasting station and they do not want at this time to invest in tube sets. Thus 60 per cent of the population at the present time is estimated to be out of range of broadcasting stations.

How may these isolated thousands be reached? We publish herewith an editorial from the December number of Radio News. H. Gernsbach, editor of that publication, has asked us to reprint his explanation of the plan and we do so with pleasure, in the hope that it may help to put radio back on the crest. What do you think of the plan? Write your views fully and mail at once to Radio Age, 64 West Randolph Street, Chicago.

The Radio News editorial follows, in part:

Suppose an up-to-date amateur, or business man for that matter, was told that with practically no outlay, he could make several thousand dollars a year out of radio broadcasting. Would he not jump at the chance? This is exactly what this scheme means. It is nothing less than *broadcasting broadcasting*

We know that most of the large broadcasting stations at the present time are receiving Arlington Time Signals on a special aerial on a wave-length of about 2,650 meters; a special receiving set is maintained for these time signals. At noon and at 10 p. m. these time signals are re-transmitted on a wave-length of either 360 or 400 meters. The telephone of the receiving outfit is simply held against the microphone of the sending outfit at the broadcasting station and the signals are thus re-transmitted.

Why not do the same thing with broadcasting programs? Suppose we have a small town of 3,000 inhabitants 100 miles away from the nearest broadcasting station. No one in that town unless he has a good vacuum tube outfit can possibly listen in to any entertainment, and if you canvass such a town you will find that there are not six such outfits in the whole community. Now, then, suppose some wide-awake amateur should equip himself with a first-class vacuum tube receiving set. This set should be an efficient loop set, preferably. Then he would also install a low-power radio telephone sending outfit. This outfit would not have to be rated higher than 10 watts. Such an outfit would cost less than $200 to assemble, including the receiver. Once the modulation problem was solved, it would be a very simple matter for the amateur to re-transmit from a wave-length of 360 to 400 meters and re-broadcast the broadcast on a 200-meter wave-length. He would have little trouble securing the necessary license from the nearest Customs House for this purpose.

Now for the best feature of the scheme: With a good 10-watt transmitter it should be possible to reach everybody within a radius of 10 miles, sufficient, in other words, to reach everybody in town. Of course, there would be needed a good transmitting aerial, but this is a matter in which we need not instruct any first-class amateurs.

The minute his station is completed, the amateur would take a simple crystal outfit, of which many can be had today for $15, complete with aerial, and visit some of his friends. He would put up a temporary aerial and let his friends and acquaintances listen in to his evening programs.

No! He would not sell, or try to sell, the crystal set to them—and here is suggested a new idea: *HE WOULD RENT IT!* You do not buy your telephone today, but you pay so much per month to the Telephone Company. Exactly so in radio. A simple contract blank could be made out whereby the subscriber agrees that upon the installation of the outfit he will pay at the rate of $2 per month.

Now, the wholesale price of a good crystal outfit, complete with phones, aerial, etc., can be had for from $10 up. Furthermore, it would not be necessary for the amateur to lay out a single dollar, for if he should be able to secure anywhere from 50 to 100 subscriptions, he could take these contracts to his bank, and if the young man is at all in good standing in the community, he will have no trouble whatsoever in securing a loan from the bank with which to purchase the outfits, the bank holding the contracts as security for the loan.

Now let us see how it works out in dollars and cents:

100 Crystal Outfits, at $10 each	$1,000.00
Radiophone Transmitter	75.00
Total Costs	$1,075.00

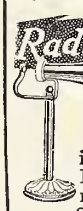
INCOME

100 subscribers at $2 per month for 12 months	$2,400.00
Deducting the original cost	1,075.00
Net profit	$1,325.00

And all this requires no investment! This is for only 100 subscribers. In a town of 4,000 it would be less than 3 per cent. It should be possible to get at least 10 per cent in any community, providing good results can be shown, in which case the profit will be over $3,000 net per year, a thing not to be sneezed at these days.

At one bound, therefore, we can put the entire country in touch with the broadcasting stations where only 40 or 50 per cent are in touch now.

There is no reason at all why this scheme can not be put into use immediately and the writer will be glad to assist the first few pioneers who try in every way possible.



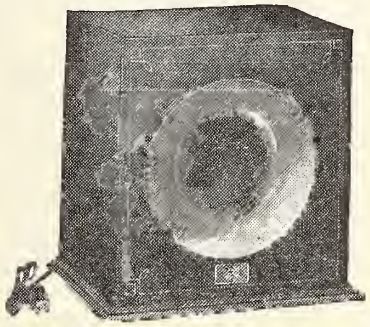
Radio PLAN-O-PHONE LOUD SPEAKER $3.50

The Plan-O-Phone is the most amazing value of any Radio Loud Speaker on the market. Remarkable acoustics. Used with any 2 stage amplifier receiving set. Fits any receiver. Made of statuary bronze—handsome, durable. Special insulating device. Nothing half so good at several times the price. Ask your dealer to show it. Mfd. and guaranteed.

$3.50 sent prepaid if your dealer can't supply you.

The Planet Radio Loud Speaker

Price each, $40.00



Weight 2½ lb., 11 in. high, Bell diam. 6 in.

Perfect Sound Reproduction

The Planet Loud Speaker marks the *most advanced step* in the perfection of Receiving Radio Broadcasting. Radio experts, "fans" and dealers, *all* are amazed at the remarkable fidelity with which the PLANET fills a room with the exact tonal qualities of the human voice, musical instruments, etc. The PLANET is a *complete unit*. Like a thing of magic it transforms the ordinary 2 stage amplifier receiving set into a wonderful musical instrument. Beautiful design, richly finished mahogany case and polished emitter with gold or aluminum finish, make the PLANET an ornamental attraction to any home. Loud, distinct, clear reproduction. Price $40.00.

The Planet Power Amplifier

Price $27.50 (without tube)

An essential unit for receiving sets that do not produce sufficient volume. Constructed so that either a five-watt power tube or amplifying tube can be used depending upon the volume desired. An article of the highest grade. It is *equipped with special units found in no other amplifier*. With the Planet Amplifier you can greatly increase your volume without distortion. Every detail of construction shows the highest grade workmanship and materials.

DISTRIBUTORS

BOSTON—Beaudette & Graham Co., 915 Boylston St.
BALTIMORE—Jones Elec. & Radio Mfg. Co., 118-20 E. Lexington St.
DETROIT—B. E. Polczynski & Co., 304 Capitol Theatre Bldg.
GRAND RAPIDS, MICHIGAN—Wolverine Elec. Corp., 21 Division St.
KANSAS CITY, MISSOURI—Western Radio Co., 6 W. 14th St.
PEORIA—Diamond Elec. Sup. Co.
ST. LOUIS—The McGraw Co., 2018 Locust St.
NEW YORK CITY—Harold M. Schwab, Inc., 419 W. 42nd St.
NEWARK, NEW JERSEY—General Mdse. Co., 142 Market St.

Planet Radio Corporation
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R. P. C. Midget Radio Pocket Receiver

Size 1-11-32x3½x6⅜

Price $3.00

THE R. P. C. MIDGET POCKET RECEIVING SET is designed to meet the wants of the novice (an opportunity to get acquainted with the mysteries of the RADIO ART) and who, having learned the A B C of Radio, may readily become a more serious student of this most important field of investigation.

This receiver is made of the finest material. It is mounted in a polished wooden case, fully equipped with a FIXED CONDENSER for tuning. It has a range of approximately 25 miles of clear, distinctive receiving.

THE R. P. C. MIDGET is truly the wonder of the age in size, price and quality. Not a mere toy but a scientifically built Crystal receiving set comparing favorably with many higher priced sets on the market.

Without head phones, $3.00 postpaid everywhere.

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Look

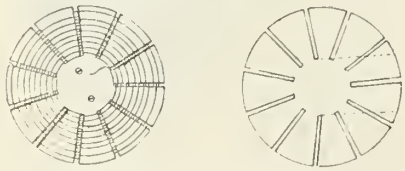
Spider Web Inductance and Discs

that give the wonderful results as described in Radio Age.

Inductance wound complete $2.00
Disc Only .. .. .50

Diagram for connections free with order.

We are manufacturers of Storage Batteries for Radio A and B circuit.



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Edeson Radio Phones
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We guarantee satisfaction, or your money refunded. The adjustment feature places our phones on a par with the world's greatest makes. Our sales plan eliminates dealer's profits and losses from bad accounts, hence the low price. Better phones cannot be made. Immediate deliveries. Double 3000 Ohm sets, $3.98; 1500 Ohm single set, $2.50. Circular free.

Edeson Phone Co. 6 Beach St., Dept 7 Boston Mass.

Send $1.00 to Radio Age, 64 Randolph Street, Chicago, and receive this middle-west radio periodical for six months. Regular subscription price is $2.50 a year. Thus you will be getting one number free.

Radio Waves Penetrate Earth

WASHINGTON, November 13.—The well-known signals of KDKA in East Pittsburgh have been heard in many places throughout the country, but it is doubtful if its call has ever been heard 100 feet below ground and at a distance of 18 miles from the station, until the Bureau of Mines experts heard it recently in a test in a mine at Bruceton, Pa.

Although the tests were hurried, only short continuous waves being used, and no attempt was made to modify the apparatus so as to try out longer waves, the experimenters found evidence that electromagnetic waves may be made to travel through solid earth.

Reporting to the Bureau, Messrs. C. L. Colburn, C. M. Bouton and H. B. Freeman, Jr., state that, in response to many requests for a device permitting the use of radio in mines in the interest of safety, especially following disasters which frequently break mine telephone systems, they recently undertook an unusual experiment, in cooperation with three engineers of the Westinghouse Electric Company.

In their official conclusions they state: "The present preliminary experiments, while unsuccessful in indicating any practical method of using wireless waves for underground communications, nevertheless indicate clearly that electromagnetic waves may be made to travel through solid strata. The 'absorption' or loss of intensity with distance is very great for the short wave lengths used in these experiments. Longer wave lengths are known to suffer less absorption and may possibly be found practically effective under certain conditions."

The preliminary experiments consisted first in receiving signals from without the mine at Bruceton by means of a receiver located inside, and second, both sending and receiving messages underground through the strata. It was found that with a receiving instrument set at a point 100 feet underground, signals from KDKA station, of the Westinghouse Electric and Manufacturing Co., East Pittsburgh, Pa., could be heard distinctly. About 50 feet from the receiving station used in this test was a six-inch bore-hole from the surface, lined with iron pipe and containing electric light wires which extended therefrom throughout the mine. The presence of these wires evidently assisted greatly in the reception, they report, for, when the receiving set was carried to another point removed from wires and tracks, the signals were barely audible through 50 feet of cover. "The fact that signals were detected, however, even though faintly, is sufficient evidence of transmission through the ground to encourage further experimenting," they state.

In sending waves underground the Westinghouse 20-watt B. T. model T. F. transmitter was used in such a manner as to send out continuous waves of 200 to 300 meters length, but they say that additional experiments with waves of increased length are much to be desired. It was found that although signals could be heard distinctly through fifty feet of coal strata, the audibility fell off rapidly as this distance was increased.

In all experiments the vertical antennae was found to give the better results, the horizontal antennae giving practically no reception. A loop of a single turn was used, however, with fair results. All these experiments were tried with a wave length of 200 to 300 meters, except the reception from KDKA which was 360 meters. The strata at the experimental mine lie almost horizontal, and may have had some influence on the transmission of radio waves, but the present experiments gave no conclusive evidence on this point. They seem to agree that the degree of wetness of the strata influenced the transmission of radio waves. The mine was a comparatively dry mine, but the overburden of soil and soft shale is damp and a small stream of water is continually flowing from the mine. The underground workings of the experimental mine follow a horizontal five-foot vein of bituminous coal, and the transmission and reception inside the mine followed the course of this vein.

In order to gain a quantitative idea of the transmission of the radiated energy a milliammeter was inserted in the plate circuit of the receiving apparatus. This normally read 1.6 milliamperes, but the flow of radiant energy from the receiving antennae produced more or less depression of the current according to the intensity of the signals. This then made possible a comparison of the intensity of the reception at different points. The milliammeter was graduated in tenths of a millampere, and tenths of a division could be estimated by eye. Signals could be clearly heard when the inflowing energy was too low to be indicated by the meter; that is, the clearly distinguished words from KDKA referred to above gave no appreciable depression of the plate current.

Any dealer, jobber or manufacturer, who is not a member of the Radio Club owes it to himself and the industry in general, to at once become active in and identified with the admittedly Best Radio Club in the United States.

Don't Wear a Truss

Mr. C. E. Brooks

BE COMFORTABLE—Wear the Brooks Appliance, the modern scientific invention which gives rupture sufferers immediate relief. It has no obnoxious springs or pads. Automatic Air Cushions bind and draw together the broken parts. No salves or plasters. Durable. Cheap. Sent on trial to prove its worth. Never on sale in stores as every Appliance is made to order, the proper size and shape of Air Cushion depending on the nature of each case. Beware of imitations. Look for trade-mark bearing portrait and signature of C. E. Brooks which appears on every Appliance. None other genuine. Full information and booklet sent free in plain, sealed envelope.

BROOKS APPLIANCE CO., 124B State St., Marshall, Mich.

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FIRST REGIMENT ARMORY

EIGHT DAYS **CHICAGO** JANUARY — INCLUSIVE — 13th to 20th

THE TIME OF YEAR THE BUILDING AND **BEST FOR PERFECT RADIO RECEPTION**

14 Sound-Proof Rooms for Loud Speakers

The Holiday Season will enable Dealers to dispose of Stock.

Inventories will be taken January 1, enabling Dealers to buy with intelligence and safety

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The exposition will be conducted along the same general lines that made a success of the FIRST NATIONAL RADIO EXPOSITION held in Chicago last June. We recognize that the boys are the active vehicle by which radio is carried into the home. As with the First National, the same with the Second National, we will have the various schools exhibiting and the students making radio apparatus for which many prizes will be given

Interest the Boy and he will sell Dad

WRITE TODAY FOR DIAGRAM

SECOND NATIONAL RADIO EXPOSITION

417 S. Dearborn St., Chicago, Illinois

Broadcasting the World Series Baseball Games

By C. W. HORN
Superintendent of Radio Operations, Westinghouse Electric & Manufacturing Company

NEW YORK CITY—and in fact the entire metropolitan district—took a vacation during the World Series baseball games of 1922. Any big athletic event is unsettling to the community in which it is held, but this particular contest between the champions of the National and American Leagues differed from anything of the kind ever held before. For radio stepped in; and the excitement of the games, instead of being confined to the few acres of the Polo Grounds, was spread broadcast by famous WJZ over a radius of several hundred miles for anyone to hear.

And millions of people did hear it. Not only was almost every receiver within range in operation, but apparently every loud speaker was placed where the public could hear its voice. One could wander around New York City all afternoon and rarely get entirely out of earshot of these instruments; and the same was true of the surrounding towns, as as far away as Syracuse. In front of the better loud-speaker installations, the crowds gathered hours before the opening of the games, in order to get good positions, and the police roped off the streets in order to protect the listening thousands.

As an auditory "spectacle" (or let us coin a needed word and call it an "auditorial"), this demonstration of the possibilities of radio is unsurpassed. Not only were the words of the official radio director, Grantland Rice, sports expert of the New York Tribune, giving every play in detail the moment it occurred, clearly heard, but also the music of the bands, the cries of the pop and peanut venders, the announcements from the field, the comments of the spectators, and above all the roars of the crowds. For the first time in history, the voices of fifty thousand people were flung out into space. The effect was deafening, overpowering, dramatic in the extreme.

Again and again, the listeners heard something like this—"Two strikes and three balls on Meuse—There are three men on bases—the pitcher is winding up"—"YE-A-A-A-A! ! !" What had happened? Was the side out, or had Meusel knocked a homer, scoring four? Were those yells from Grant or from Yankee fans? The half minute or so during which Rice's voice was utterly drowned out seemed like an hour to the waiting multitude. Then the word "Out!" would cut through, and those in the streets would add their voices to the clamor from Coogan's Bluffs.

Like all successful achievements, the thing seemed simple and easy to the audience, but it was not. The Westinghouse Electric & Manufacturing Company worked for years to accomplish it, and it then succeeded only because it received the whole-hearted cooperation of the Western Union Telegraph Company, the National Baseball Commission and the National and American Leagues, the Radio Corporation of America and the New York Tribune.

The Western Union Telegraph Company pays a large sum annually for the exclusive right of reporting all major league baseball games. Very naturally, it has heretofore refused to permit the details of any game to be broadcast, since this would materially reduce the demand for its own bulletins. But the executives of the Western Union Company have come to recognize that broadcasting as it is now being conducted is a great public service, in which both broadcasters and artists are volunteers. They knew that they controlled something that the public ardently wanted; and so, desiring to contribute their share to the development of this new art, they gave to WJZ without charge the privilege of installing a transmitter at the Polo Grounds during the 1922 series. This was indeed a generous gift to the public.

But they did more. Application was made to the Telephone Company for the necessary wires to connect the Polo Grounds transmitter with WJZ, but it was found that the proper circuits could not be obtained. This, for the moment, threatened to end the entire project, but the Western Union Company came to the rescue and placed its entire facilities at WJZ's disposal. Of course these facilities were telegraphic and not telephonic, but after a careful investigation it was decided that a satisfactory line could be arranged between Newark and the Polo Grounds.

With the aid of E. R. Shute, T. J. Smith, and M. L. Moseley, of the Western Union Company, John Frazier of the Westinghouse Company and the writer went over every inch of the wires, testing each section, locating and connecting every ground, transposing lines, changing circuits, and installing filters, until all traces of tickers, time signals, and other line noises were eliminated. This work was started three days before the first game and it seemed as though it could not possibly be finished in time. But on the day before the opening a preliminary test was made, and before it was completed word was received from Bridgeport, Conn., and Montauk Point, Long Island, that the signals were coming in good and the speech was perfectly clear.

A speech amplifier of the Westinghouse Company was installed at a point especially assigned for the purpose by the baseball officials, who were no less enthusiastic over the broadcasting than were the broadcasters. Another amplifier was connected at the Newark end of the wires, so that all sounds picked up by the microphone at the Polo Grounds reached the radio transmitter at WJZ in great volume. Technically, the success of this arrangement was complete. The loud-speaker range was fifty miles; and the clear reception range, in localities where the country was open and there was no interference from other stations, was several hundred miles.

The staff at the Polo Grounds consisted of baseball experts from the New York Tribune and operators and announcers from WJZ. All announcements were sent out under the direction of Grantland Rice; but, since it required considerable lung power to talk over the noise of the crowd at even its quietest moments, it was found best to change announcers after each inning, thus avoiding all traces of huskiness and vocal fatigue.

There is also another factor that must be clearly recognized as contributing to the success of this broadcasting; all other metropolitan broadcasting stations closed down and gave WJZ a clear field. This is the result of thorough mutual understanding, and clearly indicates that the Second District stations have the interests of the public, and not their own individual ends, at heart.

This event marks the highest point that broadcasting has so far reached. It demonstrated that all technical problems have been solved and any event can be now broadcasted on a national scale if desired. It gave the public a new view of radio's vast possibilities, when in competent hands; and it provided the most effective kind of an answer to those who, deceived by the inevitable summer slump, have doubted radio's vitality.

CLASSIFIED ADVERTISEMENTS

Six cents per word per insertion, in advance. Name and address must be counted. Each initial counts as one word. Copy must be received by the 19th of month for succeeding month's issue.

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I have nine Federal Jr. crystal sets. List $25. Will sell lot for $100. J. M. G. Care RADIO AGE.

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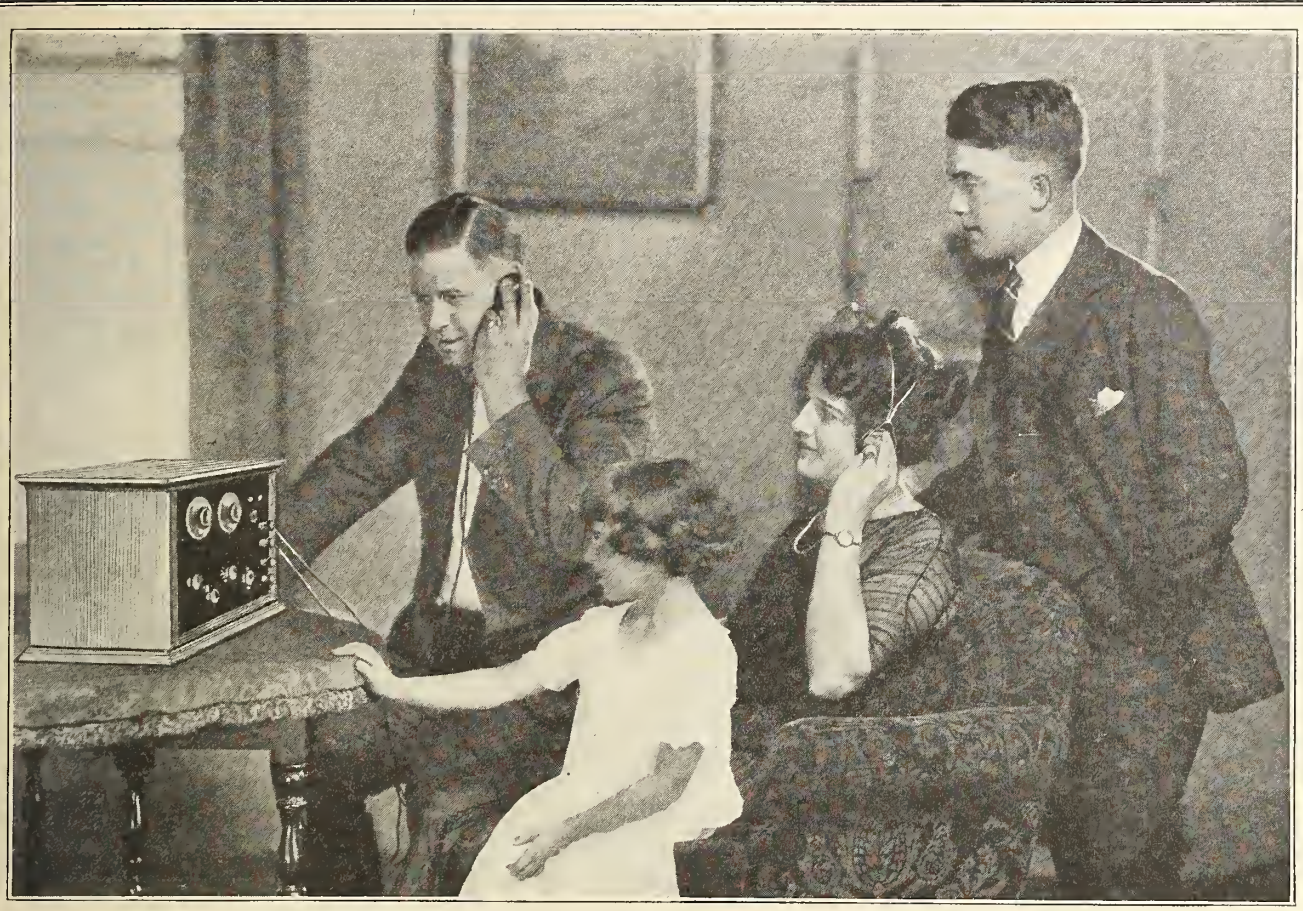

"SENSITONE" Regenerative Radio Receiving Set

$15 DOWN AND $10.00 PER MONTH
Immediate Shipment

Manufactured under Armstrong License, U. S. patent No. 1,113,149 and pending letters of patent No. 807,388.

READ THESE TESTIMONIALS!

Harold R. Wakem & Co. Franklinville, N. C.
Chicago, Ill. November 17, 1922.

Clement Cox and I received our "Sensitone" Radio Receiving Set last Saturday evening, November 11th.

We set it up Saturday night after dark. We fastened the antenna to a large water tank 65 ft. high and to a pole fastened to the house. We have heard concerts from the following stations:

KDKA Pittsburgh, Pa.	WJZ Newark, N. J.
WEAF New York City, N.Y.	WLW Cincinnati, O.
WGY Schenectady, N. Y.	WOC Davenport, Ia.
WHAS Louisville, Ky.	WOR Newark, N. J.
WIAO Milwaukee, Wis.	WSB Atlanta, Ga.

We also heard one at Fort Worth, Texas, but could not understand the call letters. I would like to be your representative in Randolph Co., North Carolina, if you have any. Three or four men at Franklinville said they were going to get radio sets since they have heard the one we got from you.

I also want to know the price of your amplifying set as we want to get one and a loud talker.

A merchant here wants a radio set with a loud speaker for his store. We fastened the ground wire to a lightning rod and it makes a very good ground.

You may publish this letter or any part of it if you wish.

CHAS. C. JULIAN.

Groveton, Texas, October 15, 1922.

Gentlemen:

Received my Radio Phone the morning of the 14th. That evening I received so many Broadcasts, I can't put them on here, although two were Davenport, Iowa, and Atlanta, Ga. Am well pleased with the machine. Heard nine stations. Yours truly, Name Furnished on Request.

Gentlemen:

F. O'Neil of Regina has a set of your wireless here, and last night I was experimenting with it and got Denver, Colorado, and Salt Lake City on the DETECTOR alone. I also picked up Havre, Mont. and Regina, Sask. Your set is sure up to what it should be. With the Two step amplifier I pick up Vancouver, Seattle, and Davenport, Iowa. We use an aerial 65 feet long and 35 ft. high.

Hoping you every success in your sets I remain, Name Furnished on Request.

Groveton, Texas, October 16th, 1922.

Gentlemen:

Inclosed you will find a post office money order for payment on my radio machine.

I heard Boston, Mass., last night, the 15th, and Davenport, Iowa, also. I also heard Wichita, Kansas. Please send me a catalog. Yours truly. Name Furnished on Request.

ONLY 500 SETS SOLD ON THE EASY-PAY PLAN

We are making this rather costly investment in order to get 500 sets in the hands of that number of influential families, so that, when we put our goods in the hands of dealers, they may have enthusiastic SENSITONE boosters nearby to whom they can refer their future prospective buyers.

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Harold R. Wakem & Co.
900 Washing Blvd. CHICAGO

HAROLD R. WAKEM & CO.,
900 W. Washington Blvd., Chicago, Ill.

Enclosed you will find $15.00 as first payment, upon receipt of which you will send me your complete Sensitone Radio Receiving Set, as described above. After I have used the set for thirty days, I agree to send you $10.00 and the same amount every thirty days thereafter, until the full purchase price is paid. This set is to remain the property of Harold R. Wakem & Co. until payments are completed.

Signed.....

Street address.....

City.....

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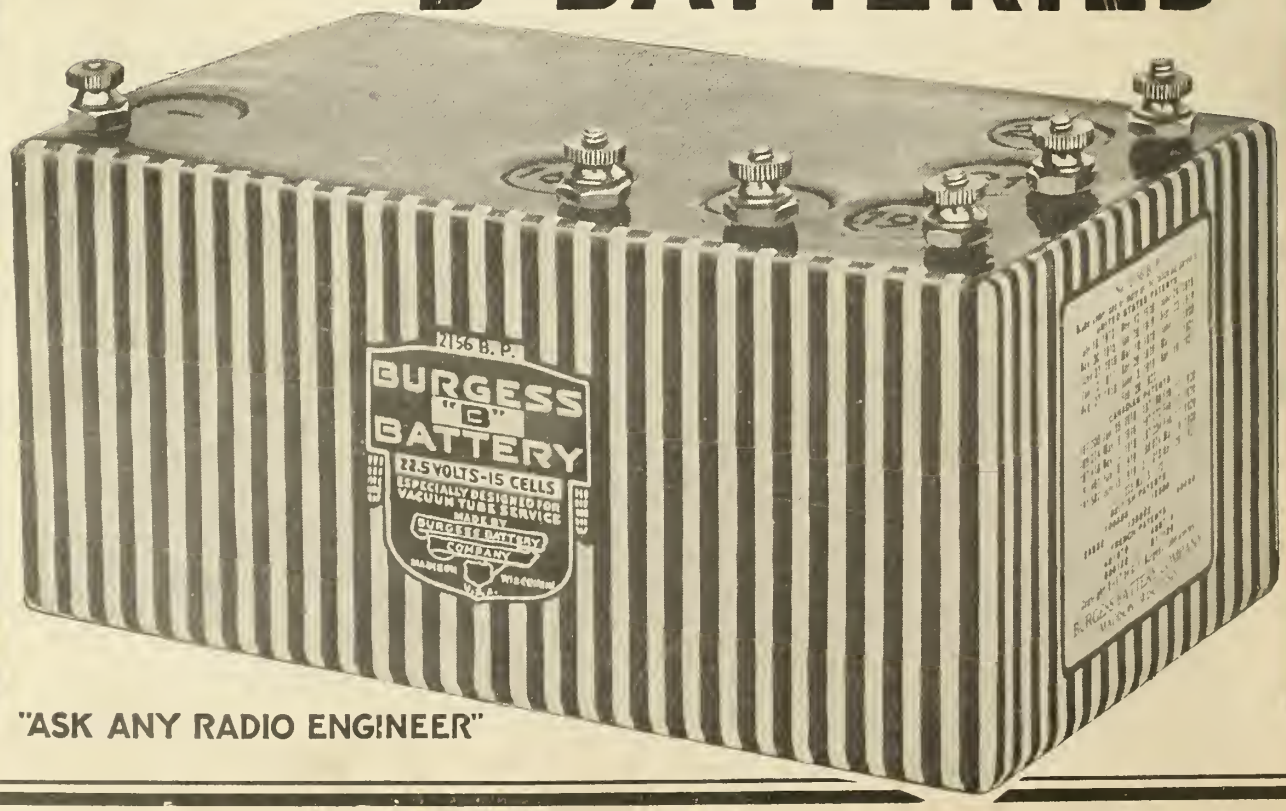

"ASK ANY RADIO ENGINEER"

"THAT LONG-DISTANCE CRYSTAL SET"

RADIO AGE

uary-
ruary, 1923

The Magazine of the Hour

Price
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CRW-9/18/26

RADIO AGE

The Magazine of the Hour

Volume 2 *JANUARY-FEBRUARY, 1923* *Number 1*

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In Which Vol. 2 Proposes Your Health

WITH this issue RADIO AGE enters upon its second year and volume and we take this occasion to say an appreciative word to those who have been going along with us through the various interesting stages of development in the wireless field.

We started modestly, but with an abiding faith in the possibility of making a middle-western radio publication that would be sufficiently interesting and helpful to find a field for itself. Long before the end of our first year readers had been registering from every state in the union, not to mention subscribers in such far-away places as Germany, Brazil, Holland and Hawaii.

It is an old axiom in the newspaper editorial office that a good story is a good story the world over. The same holds true of a good publication. If it meets with favor among the fans in the Mississippi Valley it will find friends anywhere on the radio map where English is read.

We have tried not only to present valuable and up-to-date technical information, written by authorities, but we have sought to reflect in our pages a broad vision of radio in its present social and economic aspects and in its tremendous possibilities.

Here are our thanks to the reader-family and our most cordial wishes for the new year

—THE EDITOR.

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COVERING Details on how to operate a set, how to build a set, principles of vacuum tubes, radio hook-ups etc. Standard and up-to-date Radio books; practical books for the practical man. Each written by an authority and in a manner that makes them easily understood.

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"The Magazine of the Hour"
M. B. SMITH
PUBLISHER
PUBLISHED MONTHLY GARRICK BLD'G CHGO.
FREDERICK SMITH
EDITOR

How to Make a Sharp Tuning Crystal Detector

(Here it is—the long distance crystal set)

By F. D. PEARNE

SINCE the atmospheric conditions have cleared up to such an extent that carefully designed crystal sets are getting distances never before dreamed of, the lowly little crystal is again beginning to attract attention. Everybody wants to know about that long distance crystal set, and in this article we are going to show how this set is made and why it is called the long distance crystal set. Some fans seem to think that the crystal set is not as sensitive as the audion bulb, which may be true to a certain extent, but is this due so much to the inefficiency of the crystal as it is to the tuning arrangements usually used in connection with them?

It is very seldom that one sees the finer type of tuning apparatus associated with the crystal. The Germans experience no difficulty in covering long distances with a crystal, but they use the same carefully made tuners in those sets as they do with the audion type, so why not give the crystal a chance, or at least an even break with the audion, before it is given up and thrown on the scrap heap?

It is usually taken for granted that any old type of a tuner is all right for a crystal and as a rule the crystal set is furnished with a single circuit inductance which, it is true, is capable of bringing in the 360 meter stations fairly well, but it will also respond to a wide range of wave lengths and as a result, any stations having waves from 200 to 600 will come in on the 360 meter wave adjustment, nearly as strong as the 360 meter station, which makes it practically impossible to hear any

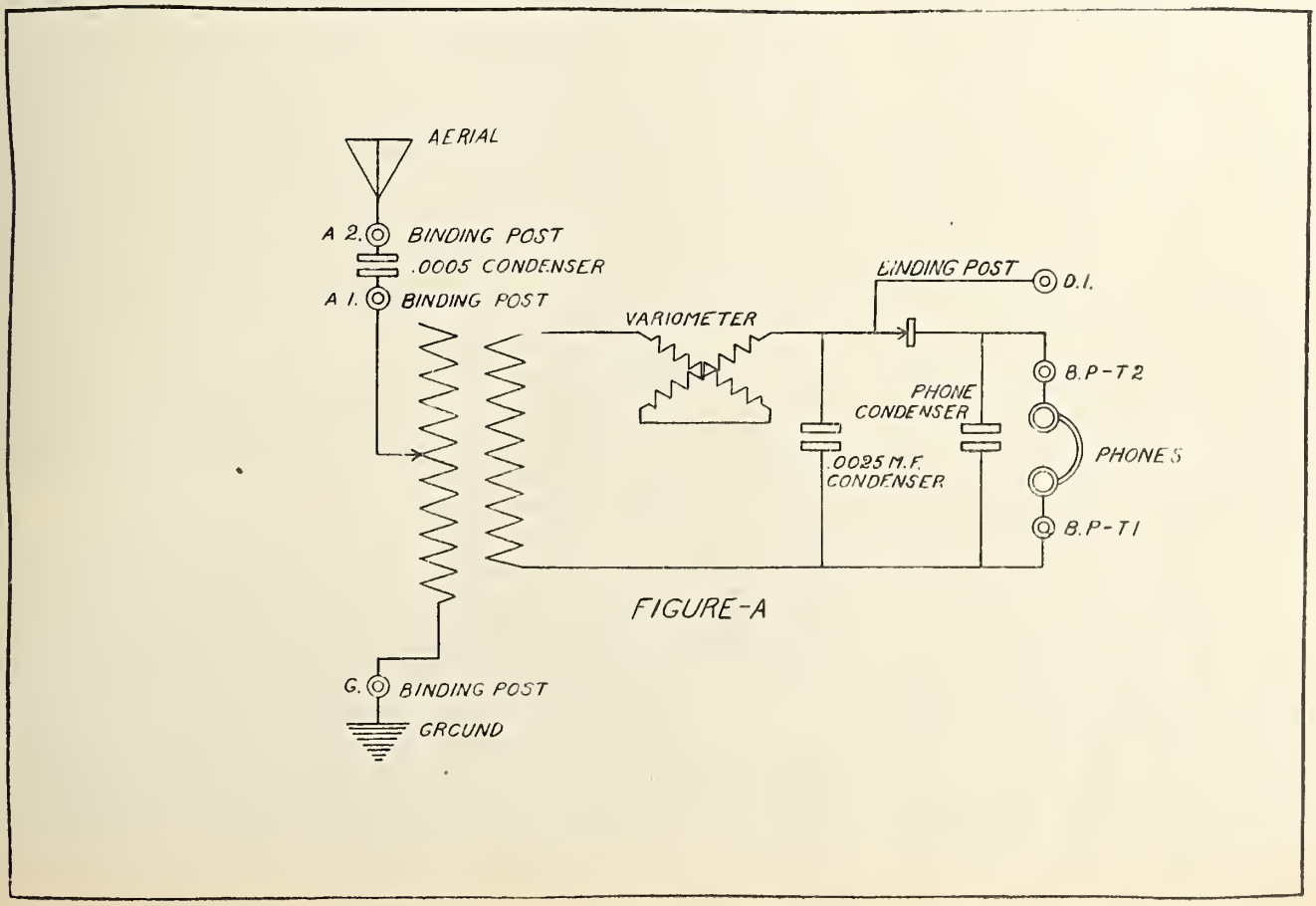


FIGURE-A

selection entirely through without frequent and noisy interruptions.

And another thing which makes confusion particularly bad is the fact that often several stations broadcast at the same time, on waves of the same length. A single circuit set is incapable of selecting any one of these waves by itself, which must be done if clear reception is to be expected.

Figure "A" shows a crystal detector receiving set, so designed that sharp tuning is easily obtained. The parts are easy to construct and yet are rugged and durable. A series condenser of .0005 M. F. capacity is provided, to permit two wave length ranges, and an extra binding post for the addition of an audion detector is also added. A vario-coupler is used for taking advantage of the sharp tuning characteristics of a loose coupled circuit, and a variometer and fixed shunt condenser allow close regulation on the secondary.

The variometer is used in place of the variable condenser in order to employ a minimum of capacity and a maximum of inductance at all times. This gives a higher voltage on the detector. The circuit as shown can be either mounted on a table, or enclosed in a cabinet as desired.

No attempt has been made to load the circuit for 1450 meters, because the dead end effect would defeat the efficient design for short wave work. If it is desired to receive waves of this length, a special vario-coupler may be supplied with a double pole, double throw switch, by means of which it may be thrown in or out of the circuit. While the construction of the crystal receiver shown is not difficult, it is intended more for those radio fans who have already experimented with single circuit sets and are anxious to obtain something which will really give continuous satisfaction and enjoyment. It is not essential that the parts used be of the highest quality which can be purchased, but if such high grade material is used, the certain result will be a more efficient, more durable, and a better looking set.

For ordinary 360 meter work, the aerial is connected to the binding post marked "A" 1, and the ground to the post marked "A-2," which will include the condenser in the aerial circuit. An audion detector may also be used with this set by connecting the audion input to the upper and lower binding posts marked "D-1" and "T-1" as shown on the drawing. An extra variometer might then be added to make the set regenerative. This of course should be placed in the plate circuit. To adjust the set, the coupling should be set at maximum, that is, the windings of the rotor of the vario-coupler should be in a horizontal position. The crystal should then be adjusted and the variometer turned until the signals are heard, then the coupling is gradually reduced, that is, the rotor should be turned at a slight angle and then the variometer is again adjusted until the signals come in. This process of changing the coupling should be carried on until the tuning becomes very sharp and the interference from other stations is entirely eliminated.

The phone condenser shown in the drawing is an ordinary fixed condenser, such as is usually sold for this purpose. It should have a capacity of .00025 M. F. The detector may be any of the standard crystals, but should be carefully tested to make sure that it is the best that can be had for the purpose. The binding posts are conveniently arranged in the proper parts of the circuit to make the addition of any of the ordinary audion circuits a comparatively easy matter.

It will be plainly seen by looking over this circuit that there is no special reason for calling it a long distance crystal set, other than the fact that the apparatus used simply makes it possible to get much finer tuning, which is really the cause of the increased range. The signals reach the crystals in most cases, but are not audible to the ear for the reason that the tuning mechanism in most cases is not sufficiently sensitive to make the signals audible.

The circuit described in this article admits of such close tuning that it is possible to pick up stations which can not be found on the ordinary crystal set. To get the best results, the aerial should be made of one single wire 150 feet in length, and as high as possible. This should be placed in a position which is as free from obstructions as possible. The ground should also be of the best, and if these conditions are followed out to the letter, the user will be surprised at the results which can be obtained with a set of this kind.

Halt Radio Tax

The proposed Chicago radio ordinance, which has been under consideration since last summer, struck another static screen and was put over for further consideration early in January.

The ordinance, drawn by the department of gas and electricity, was designed to protect radio fans and the public generally from hazard to life and property by improperly constructed outside aerials, and provides a fee for inspection, which the radio user must pay. This fee ranges from $1.50 to $3 per set.

At a public hearing of the council committee protests against the ordinance were plenty, the support coming only from the representatives of the department of gas and electricity. Chairman Adamowski gave everyone who wished an opportunity to talk and protests were voiced by Secretary John P. Tansey of the Radio Club of Illinois, George Foster of the Commonwealth Edison Company, Thorne Donnelley of station WDAP, F. D. Pearne and others.

"I do not think the city should take action in advance of the final report of the government on its plan for regulating radio," said Mr. Foster. The opposition was apparently so unanimous that a motion to file the ordinance and forget was on the point of passing, when Alderman Link asked:

"Is there any one here that favors the ordinance?"

Messrs. Tousley and Nixon of Commissioner Carlson's department declared that the electrical inspection department has knowledge that many aerials now constructed were hazards, and that it was but a question of the first heavy sleet storm when they would come tumbling down upon high-powered electric light and power wires with resultant short circuits which might mean fire or personal injury to many.

"Everybody who has protested is interested in radio," said Mr. Touslet. "Naturally they are against any restriction, but the city department owes it to the rest of the public to offer them the protection we know they need."

It was decided to lay the matter over until after the first of the year, and meanwhile carry on a campaign of education of the public as to the real protective purposes of the ordinance—[W. J. Clarke, in Chicago Evening American.

International Aspects

H. Gordon Selfidge, Jr., Assistant Manager of the Merchandising Division of the Great London Store, speaking from WJZ, the Radio Corporation-Westinghouse Station at Newark, recently addressed the radio audiences of England and America on the International Aspect of Radio Telephony. A cable was sent to the amateurs in England notifying them of the time of the address.

Fees for Composers—None for Broadcasters

By **FREDERICK SMITH**

If this were not a sob story it would make you laugh. Broadcasters of radio programs have been entertaining the American public free of charge for a year, spending thousands and hundreds of thousands of dollars, without a cent of return—and along come music composers, song writers and authors and ask for one million dollars per year in fees from the broadcasters.

It happened in New York. Most everybody was there excepting a million or so "listeners-in" who thought there was to be no alloy in this joy of hearing songs and jazz tunes from their favorite broadcasting stations. They—the listeners—had the fantastic idea that the composer of a jazz tune should be sufficiently repaid if the station announcers told the world that his "piece" was about to be played for an audience of 500,000 or more. Some advertisement of a bit of music, you might say.

But the composers are a thrifty lot after all. It seems that they are not the long-haired, temperamental scorners of money-wisdom that the popular novels and the comic strips had portrayed. They want their sixteen ounces of flesh, according to the bond. If their demand should kill radio broadcasting, why let broadcasting die!

The composers, authors and publishers had heard that the radio goose was laying a lot of golden eggs (a pretty fable) and so they decided to go after the goose. Therefore:

The American Society of Composers, Authors and Publishers served notice on all broadcasters that the broadcasters either must obtain license to broadcast copyrighted stuff or face suits for violation of the copyright law.

A conference had been held, prior to this momentous decision, at which were represented the American Society of Composers, Authors and Publishers the Authors League of America, the Music Publishers' Association, the Music Publishers' Protective Association and the Radio Inspector of New York, the American Telephone and Telegraph Company, the Radio Corporation of America, the General Electric Company, the Westinghouse Electric and Manufacturing Company, the National Radio Chamber of Commerce and I. R. Nelson & Co.

An impressive representation. E. C. Mills, Chairman of the executive board of the Music Publishers' Protective Association, made the naive suggestion that if the broadcasters paid for licenses issued by the A. S. C. P. they then would be in the fortunate position of being able to broadcast only A. S. C. P. compositions. The broadcasters would not need to broadcast anything else.

Some of the broadcasters present at the conference declared they would, in the most gentlemanly spirit, of course, see composers, authors and publishers in the notoriously bottomless pit before they would pay for giving the public the biggest kick the public has had since Mrs. O'Leary's cow kicked over the well-known lantern. They said they would go on the air with "The Old Gray Mare, She Ain't What She Used To Be" rather than pay money to the A. S. C. P. for the privilege of broadcasting the latest copyrighted Broadway and Forty-second street sensation, "My Bromo-Seltzer Bride."

J. A. White, of the Radio Corporation of America, said that there was little possibility of adding further to the burden of the broadcasters, who as yet have been unable to obtain any compensation from the public for their expensive service. Mr. White said:

"Owing to the suddenness with which the art of broadcasting has sprung into existence the fact that as yet its activities are largely unorganized and that our government has not yet legislated or regulated the operation of stations, the Radio Corporation of America does not see its way clear to accept the suggestions for compensation made by the American Society of Authors, Composers and Publishers."

"The American Society of Composers, Authors and Publishers has in its hands the power, to a certain extent to mould the future of broadcasting," said M. P. Rice, speaking for the General Electric Company. "If it is made too expensive, if it is made too impracticable to utilize popular music for broadcasting we will turn to something else. If whatever we turn to is unsuccessful then broadcasting may die.

"If we are forced out of the music field we will be forced into some other field. And if the public puts down its receiver, so to speak, and walks out, then broadcasting is dead."

The fee mentioned by Mr. Mills was a minimum rate of $5 a day. If all broadcasters paid this fee to the American society its annual revenue would exceed $1,000,000 from that source alone. Mr. Mills, however, said that the $5 figure was "a point to talk up from or down to."

Radio Entertainment For Hire by the Evening

A WASHINGTON radio company has established a radio entertainment service for hire. The concern proposes to supply radio service on call, just as an orchestra would sell its services for an evening.

This company undertakes to send an agent to homes or halls with a radio set which will be installed and with which an evening's social entertainment may be obtained or "no charge." After the concert, or whatever the program may be, the radio man packs up his receiving set and goes on his way with his fee.

Those broadcasting stations which conduct radio shops might find this method a means of getting some return on their investment.

"Send us a radio set and an operator. We want to dance."

Sounds interesting, doesn't it?

Radio Exports Increase

Domestic exports of radio apparatus during the month of October totaled $207,535 and weighed 114,309 pounds, according to figures compiled by the Department of Commerce. The value of these radio shipments was as follows: England, $70,391; Quebec and Ontario, $35,728; Argentine, $32,092; Brazil, $27,072, and Japan $11,299, the balance going to twenty other countries.

Show Postponed

Postponement of the Second National Radio Exposition has been announced. Milo E. Westbrooke, director of the exposition says that information as to the date of the show will be sent out later.

The exposition was to have been held at the First Regiment Armory, Chicago, January 13 to 20, inclusive.

Gen. Squier Sees a New Era

WASHINGTON (Special to Radio Age).—Radio development advanced several lengthy strides during the past fiscal year through broadcasting, technical research and the application of advanced design to military communications, according to the annual report of Maj. Gen. Geo. O. Squier, Chief Signal Officer of the Army.

Through the operation of the Army Radio net, established in May, numbering 60 stations on November 30, the Signal Corps saved the Government $14,357 in the transmission of official communications, over what they would have cost at commercial rates. These radio stations established in corps areas in Continental United States and in their sub-divisions handled a total of 40,494 messages in the seven months of operation, cooperating with Naval coastal radio stations in some instances.

The Army radio stations at Nome, St. Michael, Holy Cross and Iditarod in Alaska have been rehabilitated, and new and powerful sets with a range of about 150 miles have been installed at Nulato and Wrangell. Signal Corps installers were working at the Noorvik, McGrath, and Bethel stations, and equipment was en route to Fort Egbert and Ruby, at the end of the fiscal year. Equipment for the Craig station was also available, leaving only three stations in the territory awaiting new apparatus.

"The outstanding feature of the year in signal communication undoubtedly has been the phenomenal development known as 'broadcasting' ", said General Squier. The suddenness of this development he believes, has no parallel in the application of science to everyday life. "In the educational field alone," he states, "we are on the threshold of a new era which will probably affect our modes of life."

Pointing out the importance of wireless communication in both peace and war, the Chief Signal Officer explains that the Signal Corps is endeavoring to keep abreast of all developments with a view of utilizing and assimilating them for Army purposes. The experiments conducted in his office broadcasting over electric light lines in an effort to reduce the interference in the ether, and with the "super-phono," a method of secret line-radio communication, are cited as examples of practical experiments undertaken recently.

Although handicapped by both a reduction of funds and personnel, the division of the Signal Corps entrusted with communication, research and development, completed 78 new specifications of radio sets and apparatus, together with 300 drawings during the fiscal year. Among the accomplishments in radio engineering was the perfection of a new radio telegraph set for Infantry batallions for communicating with regimental and corps headquarters. This set has a five-mile radius and employs waves between 75 and 77 meters, but is capable of ten settings or different notes between its extreme waves. One of its advantages is a portable square loop about 9 feet, which can be folded up. It also has directional features. These sets are now in production for the Infantry Corps. Another set, designed especially for division or corps headquarters, employs six 250-watt tubes in transmitting. This gives a telephone range of about 100 miles and a telegraph range of practically 600 miles. The set is portable in that it can be mounted in tractors for field transportation. A tube set was developed for use in permanent stations with two 50-watt tubes operated from storage batteries for both telegraph and telephone transmission. The sending and receiving units are separate and the range is about 150 miles.

For the Air Service two 100-mile range telephone and telegraph sets were especially developed; one for large airplanes like the Martin Bombers and the other for use at ground or base stations. The ground station apparatus uses two 250-watt tubes in place of ten 50-watt tubes. Since the end of the fiscal year contracts for the development of both these designs have been let to commercial electrical companies for completion. The perfection of a five-mile range set for inter-plane communication employing the Armstrong receiving system and intended to be used on pursuit planes in formation flying, has also been placed in the hands of manufacturers, due to lack of Signal Corps personnel.

Contracts have been awarded for the production of a number of new airplane radio sets with a 30-mile range, using two 50-watt tubes. The apparatus is split up into several units which are distributed in the plane and controlled from the dash board by the pilot. Work on a radio telephone mule pack for use in mountain artillery was also underway but uncompleted at the close of the fiscal year. Considerable progress in the design and testing of a radio telephone set for use in army tanks was accomplished. The development and test of a five station inter-phone set for use in the Martin Bombers was also progressing well, it is reported by the Chief Signal Officer.

Other developments included work on a field telephone repeater for use in coupling line and radio communication, especially in balloon communication; the perfection of a direction finder for the Coast Artillery Corps, and tests with the resonance wave coil antenna for the el mination of static, revealed that where large antenna cannot be erected, and on portable sets, this apparatus may be of great advantage.

Boys Start Paper

We have on our desk the first two issues of "Radio Research," a neat periodical published by the Radio Research Club of the Springfield (Ill.) high school and printed in the high school print shop. A. B. McCall, instructor of mechanical drawing in the Springfield school and faculty advisor of the Radio Research Club, writes us that the paper has aroused great interest and after carefully looking it over we are not surprised that the boys are enthusiastic about it.

The paper contains technical articles, a questions and answers department, editorials and news notes. It is supported by advertising from local merchants. The staff is comprised of Roy S. Skaggs, editor; Edward E. Henry, circulation manager; Charles F. Cochran, advertising manager.

It is probably the first publication of its kind in the country and we suggest to radio fans among the schools in other cities that they write to the circulation manager of Radio Research, Springfield high school, Springfield, Ill., enclosing two cents for a sample copy. The circulation manager says "send no stamps."

For our part we welcome "Radio Research" into the radio publication family.

Radio for Insane

A new radio receiving set has recently been installed at the Government Hospital for the Insane at Anacostia, D. C., by the Department of the Interior. The set has a receiving range of about 750 miles and enables the inmates to receive concerts every evening from many different sending stations.

Harbord's Views on Broadcasting

GENERAL James Guthrie Harbord, Deputy Chief of Staff, United States Army, and President-Elect of the Radio Corporation of America, spoke before the Illinois Manufacturers' Association at Chicago, on December 14. He discussed the interesting question as to who shall pay for broadcasting and various other radio problems. He said in part:

"Since Gutenberg invented his rude movable type blocks and made printing possible nearly five hundred years ago, no one invention has more closely touched human interest and human welfare than your new business, the public's new business, my new business, RADIO. It is of one phase of that new business that I shall endeavor to speak to you tonight, without pretense to expert knowledge or technical accuracy, or even in technical language.

"I think any of you can understand with what keen regret a man leaves a profession to which he has been devoted from early manhood, and which has been very dear to him for over thirty-three years. Yet there comes a time when a man can see that his own particular work has had the best that he could give it, and that his own and his employer's interests may be well served by attempting constructive effort in another, but not unrelated line.

"It was after much consideration that I accepted the great responsibility of the Presidency of the Radio Corporation of America, and decided to leave the active list of the Army. I believe that I can be of service not merely to the Corporation but through it to the people of our country and to our Government, and perhaps contribute to guarantee the peace of the world by helping to develop national and international communication facilities.

World Communication

"Certainly for peace or war no action could have been wiser and more far-sighted than that of certain representatives of our Navy at the close of the World War, when with memory fresh from their experiences in that conflict, they appealed to the General Electric Company to form a single independent Wireless Company for the purpose of establishing:

"1. An American owned, operated and controlled radio communications company, powerful enough to meet the competit on of the radio interests of other countries.

"2. Such an international communications system that America would not be dependent upon foreign-owned cables.

"3. Providing for the construction and operation of radio stations at home and abroad under such terms and conditions as would best serve the needs of the American people and their Government.

"4. Preserving to America the wireless apparatus which had been invented and developed in this country after many years of patient and costly research and experimentation.

"Other countries, encouraged by their practical control of the transoceanic cab'es, were already in the

MAJ. GEN. JAMES G. HARBORD, Newly Elected President of the Radio Corporation of America

wireless field, and the problem was to establish America in international communications as soon as possible. The General Electric Company, quick to heed this SOS call made by the Navy representatives, patriotically responded even though such response involved a departure from its traditional policy, and at once broke off negotiations already under way by which the domination of air communications would have passed into alien hands. The wireless patents, inventions, and research facilities of the General Electric, and American Telephone and Telegraph, and United Fruit, and the Westinghouse Companies were speedily brought together in the Radio Corporation of America, so that it might do its great work free from previously existing patent restrictions essential to the immediate development of a Communication system, all American in its ownership and control, but serving the whole wide world. This culmination of negotiations bringing these great electrical concerns together has been instrumental for making America the heart of not only the wireless systems of the world, but the chief of all the nations in the development of long distance wireless telegraph stations, ship-to-shore wireless telegraph and telephone sets, to say nothing of that art second only to the printed page—*wireless telephone broadcasting.*

"Broadcasting appeals to the imagination as no other invention of the times. Its possibilities are beyond human comprehension. It is the romance and the inspiration of the world's splendid prime. No permanent record of the last act of "Il Trovatore" as given by the Chicago Grand Opera Company in your auditorium here, three weeks ago, Saturday night, and as actually heard in New York—no record though equally perfect in its reproduction is equal or comparable to hearing it by radio at the second it was given. One is history, the other, *action*, timely and instantaneous. Think for a minute of the psychological charm in hearing the voice of Galli-Curci, or the President of the United States, before it is heard by the people sitting in the last row of the Orchestra Circle, or in the last row of the Gallery of the Senate of the United States. Think of sitting in your own homes in Springfield or Bloomington by a comfortable open fire, and being transported through this modern miracle to the Yale Bowl in distant New Haven, and seeing in your mind's eye, play by play, the men from Iowa—our own great west—defeat the sons of Yale. You are told that the weather is perfect, the Bowl is filling up; the teams come on the field; you hear the bands; you are moved by the cheers of the crowd; and when the station rings off, in the silence of your own home you share the elation of victory and sympathize perhaps with the bitterness of defeat.

The Program

"The successful program manager, in order to satisfy the public, must be an interpreter of public

taste and opinion—a musical critic —a spiritual adviser—a theatrical manager—a statesman, and an expert on education, who seeks to satisfy your wishes. I am told by my future associates that thousands of letters have been received at the large stations, intended either for the management or for the artists who perform. These letters come from bedridden individuals who never dared hope to hear again their favorite concert artists. WAM believed they were doomed to humdrum lives without ever again seeing the world outside of their sickrooms. From blind men and women and from children have come letters with wonderful heart appeal, which compensates those who have devoted their lives to the development of this art.

"Mothers, too, write in an endeavor to get the wireless telephone to assist them in making their naughty boys behave. The mother of one Johnie Owen wrote a letter, in which she said she hoped the sending station would issue a personal message to Johnnie, whose ears were glued to the radio receiver for the evening 'bedtime story'—telling him to wash his face, brush his teeth, and in other ways, be a good little boy.

"About four weeks ago, one of the large stations in New York started broadcasting the regular Sunday morning services from St. Thomas' Church. In the course of the service, Dr. Stires announced that the offering for that day would be used for the poor of the parish—and on the following Tuesday, Dr. Stires received a letter postmarked from a small up-state community. It said that the writer and his neighbors, there being no church in their immediate neighborhood, had heard the services, and had noted that the collection was for the poor of the parish; that they had taken up a collection, and there was enclosed a check representing their contribution.

Service Rendered

"The value of broadcasting to any individual or community will be in proportion to the difficulty of getting the same thing by any other means. Next to saving life at sea, radio's greatest service should be to the agricultural sections of this country. It will serve the farmer and those who live in small communities as no other utility has been able to serve him. It is already bringing him time signals, weather reports, market reports and agricultural information. Not until agricultural extension courses, religious services, opera, entertainment and education, which are now available in the cities, are regularly brought to the farmer by radio, will it have fulfilled its mission to American Agriculture. What all this will mean to you, Gentlemen, who are Executives of companies manufacturing all of the products consumed by the average American, you are better able to answer than am I. But I am sure, that radio cannot help but bring all sections of our country closer together and improve its moral, social and economic standards.

"Commercially successful wireless telegraphy is only two and one-half years old, but it is to-day handling twenty-five per cent of the international message business of the United States. While successful broadcast wireless telephony is just a year old, or I might say a year young, the progress made in that year is nothing short of a miracle. But it has only opened the door to the marvelous future, and if we are to make broadcasting of social economic, religious and educational value; a value close to the power of the newspapers, of the history and of the literature of all time, broadly speaking, the problem, except for refinements, is no longer to develop the art scientifically, but to muster our forces for the purpose of making radio of maximum service to all of the people of the country.

"There are in the United States, in round numbers, six hundred broadcasting stations ranging in power from less than ten watts to more than one thousand watts. The small stations of doubtful technical perfection are serving purely local needs with intermittent programs. The large stations—only thirty in number—technically correct and operating on permanent schedules, are serving as large group as is possible with programs of quality, varied to meet the demands of the hundreds of thousands in their unseen audiences.

Some of the Problems

"Today, we have newspapers, automobile schools, electrical manufacturing companies and chiropractic schools doing broadcasting. Can these various agencies continue when it costs from twenty-five to fifty thousand dollars a year to put on continuously a generally satisfactory program? If not, who is to do the broadcasting? Theoretically, the 600 stations scattered throughout this broad country are operating on two wave lengths, one of 360 meters and the other 400 meters. The result is man-made interference and confusion. One of two things happens, either good programs suffer from this interference, or stations capable of serving many thousands are asked to give up time on a specific wave length to a smaller station which can at best serve only small communities and a limited number of people with inadequate programs.

"It is popularly believed that radio communications being carried on through the air may be operated to an unlimited extent. That, unfortunately, is not true. The spaces that scientists call the ether, through which communications may be carried on, are very limited. They are like a definite number of paths, or a city street upon which only so many soldiers can march shoulder to shoulder. The Government can assign additional wave lengths, but there are not available in the ether 600 wave lengths which can be allocated to telephone broadcasting.

"Under existing international and national laws and regulations, twelve instead of two wave lengths could be made available immediately for this service, and if these were allocated and properly staggered over the whole country, we could even then have only 46 first-class broadcasting stations. But these 46 stations would operate with a minimum of cost as well as a minimum of interference which is more important if we are to realize immediately upon the possibilities of radio.

"Our problem is therefore national and not local. What is urgent is a national service which will take into account the best utilization of wave lengths so that the greater service will be rendered to the greatest number.

Pay for Broadcasting

"Who is going to pay for broadcasting? I cannot answer that question, but if we have a national service organized and administered, with the slogan, "*The greatest good to the greatest number*," as the watchword, it will no doubt be possible to devise some means of obtaining compensation for the cost of service either from manufacturers and distributors of apparatus, suitable contribution from listeners, or by the public-spirited endowment of a Carnegie or Rockefeller.

"Gentlemen, I have touched but lightly on the possibilities of *broadcasting*—perhaps, even less on constructive suggestion as to its problem. Think what the broadcasting to hundreds of thousands of homes would have meant to Theodore Roosevelt with a recalcitrant Congress on his hands; or what possibilities it would have held for President Wilson in rallying public opinion to the support of the Great War, in confusion to pacifists and slackers.

Description of Fixed Condensers Used With Simple Homemade Radio Receiving Sets*

By the U. S. Bureau of Standards

THIS circular describes two "fixed" condensers which are used with either of the radio receiving sets described in the first or second circulars of this series. One of the fixed condensers which is connected in series with the antenna, will be called in this circular the "series-antenna" condenser. The other fixed condenser, which is connected across the terminals of the telephone receivers, will be called the "telephone-shunt" condenser.

The effect of the series-antenna condenser is to enable the receiving equipment to give signals of somewhat greater intensity when tuned to wave frequencies above 1,000 kilocycles per second (that is, wave lengths of 300 meters or less). It will thus be seen that the effect of this condenser is just the opposite of the effect obtained by a greater number of turns of wire on a tuning coil, which, it will be remembered, permits the receiving equipment to respond to lower wave frequencies (longer wave lengths).

The effect of the telephone-shunt condenser is to increase the intensity of some radio signals to which the receiving set may be tuned. In most cases, the use of this condenser has no effect upon the intensity of signals which are received from a radio telephone transmitting station, but will increase the intensity of radio signals which are received from most spark transmitting stations.

Series-Antenna Condenser.

The series-antenna condenser is shown in detail in Figs. 1A and 1B. Two thin strips of metal (C and E) 1 inch wide and 3 inches long are used with three sheets of insulating material (B. D, and F), 1 1-2 inches wide by 3 inches long. The metal strips may be thin copper, brass or aluminum. Each of the three sheets of insulating material is made up of two pieces of heavy white writing paper which are separately dipped in clean, melted paraffin. Each pair of sheets is then pressed together by means of a warm iron, and when cold the strip is cut out to the required size. A sheet of clear mica having about the same thickness as the two sheets of writing paper mentioned above may also be used for the insulating material. Two blocks (G = 2 5-8″ x 3″ x ½″, A = 3″ x 3½″ x½″) are cut out and preferably from hard wood. Two screws pass through holes, H and J, in the upper cap block G, which is placed over the base block A, so that the edges of the two blocks are even on three sides. (See Fig. 1A). The holes for the screws, H and J, are 3-8 inch from the sides of the cap block G and equally distant from the ends. Having located the correct position of the cap block G, the screws in holes H and J are loosened and the cap block is removed from A, leaving two small holes H′ and J′ to locate the proper position of the blocks when the condenser is finally assembled. The two screws L and M are located just far enough in from the front edge (See A, Figs. 1A and 1B) so that the block A may be screwed to the left end of the baseboard of the receiving set described in Circular No. 120 or to the primary coil support described in Circular No. 121. (See Figs. 2 and 3).

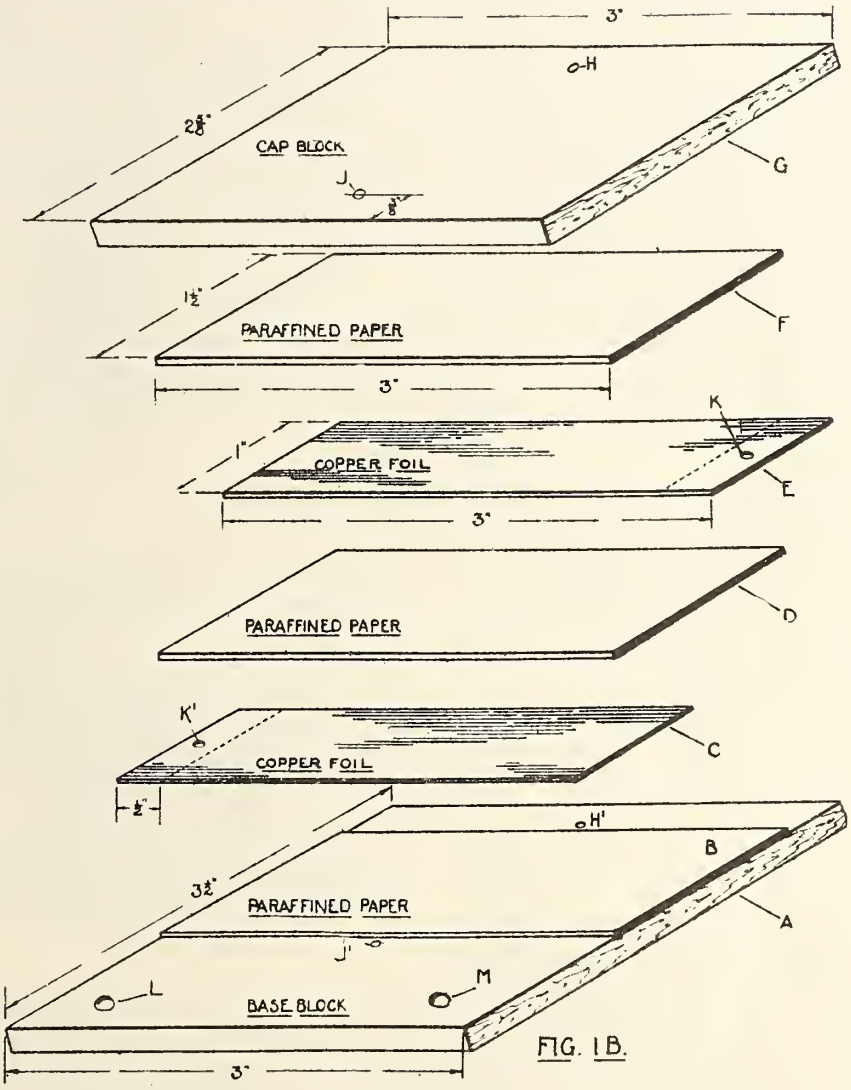


FIG. 1B.

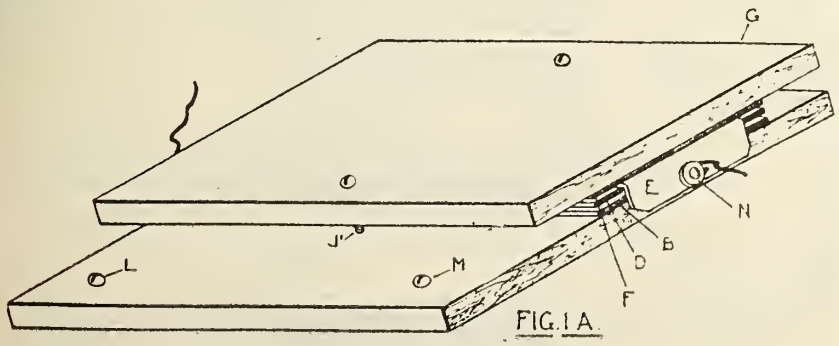


FIG. 1A.

The wooden blocks are of dry wood smoothed up with sandpaper and given a coat or two of varnish which will not absorb moisture, or treated with paraffin as described in Cirular No. 120.

A sheet of the paraffined paper or mica B is placed on the base block A between the holes H′ and J′ so that its ends are even with ends of the base block. A thin metal strip C is placed in position so that it lies in the center of B and has its right end ½ inch in from the edge of the base block and its left end projecting ½ inch over the opposite edge of the base block. (See fig. 1B).

Another sheet of paraffined paper D is placed on C directly above B. The second piece of thin metal E is placed on D above C, except that one end of the metal strip E extends ½ over the *right* edge of block A instead of the left as did C. The third sheet of paraffined paper F is placed on E directly above D and B.

The alternate sheets of paraffined

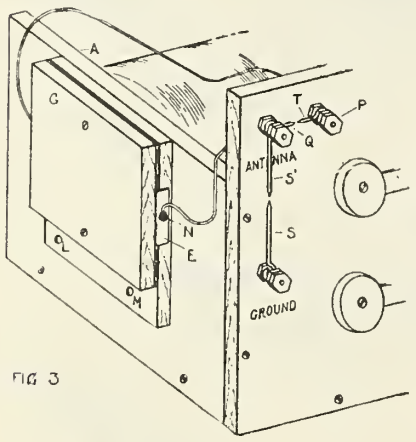


FIG 3

paper and thin metal are held carefully in position, and the cap block G is placed over them and screwed in position. The right end of the thin metal strip E is bent down, and a round head brass screw N is passed through a hole K, punched or drilled in the end of the metal strip. The projecting end of the strip C is not visible in Fig. 1A, but it is bent and fastened in the same manner as E. The completed condenser resembles the sketch shown in Fig. 1A.

Mounting and Wiring.

The condenser is mounted on either the single-circuit receiving set described in circular No. 120 or the two-circuit receiving set described in Circular No. 121. Fig. 2 shows the method of mounting the condenser on the single-circuit receiving set. The condenser is fastened to the end of the baseboard by means of the screws L and M. A binding-post P is added to the panel of the receiving set about 1 inch from the binding-post marked "antenna," as shown in Fig. 2. A wire is clamped under the condenser screw N which passes through the metal strip E, forming one terminal of the condenser. This wire is led to and connected to the back of the binding-post marked "antenna" without disturbing any of the other wires which are already

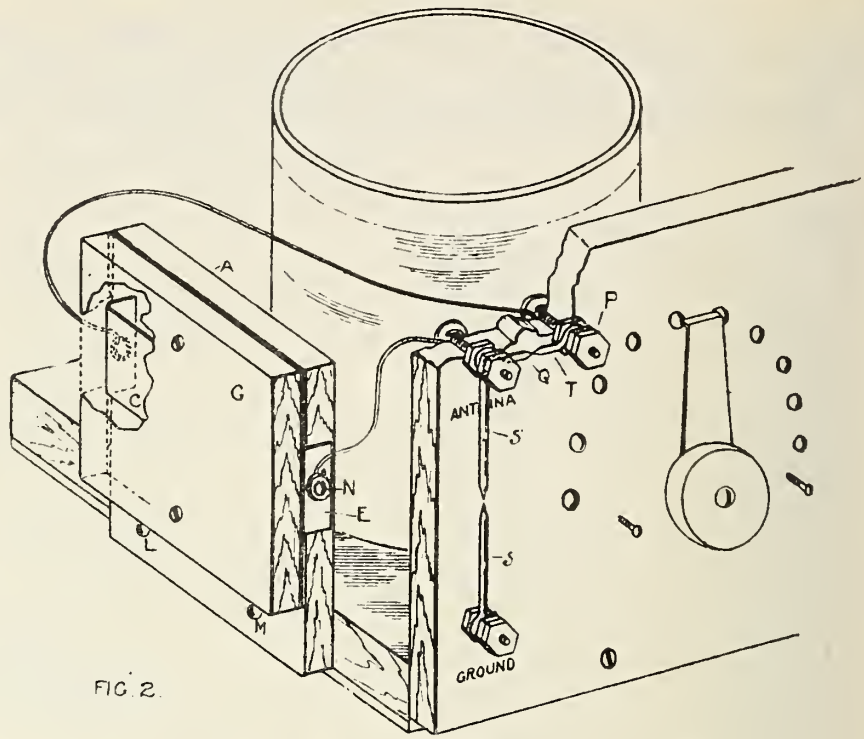
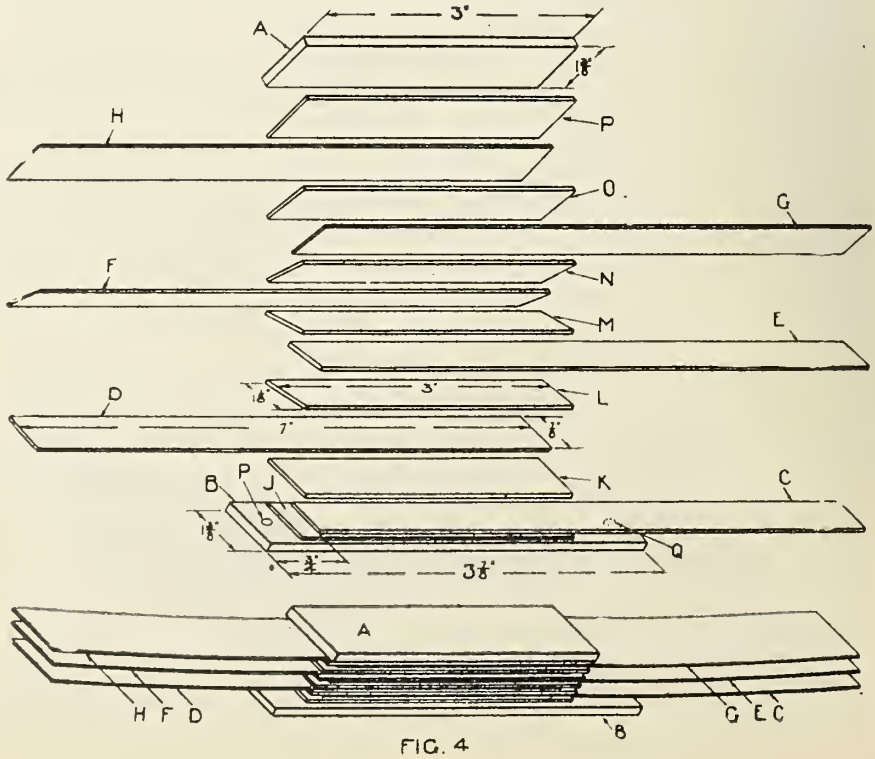


FIG 2.

connected to this binding post. Another wire is connected to the terminal of the metal sheet C and led to the back of the binding-post P.

In circular No. 120 a short stiff wire is shown attached to the antenna binding-post and extending toward a similar wire attached to the ground binding-post. The wire on the antenna binding-post is removed and a longer one substituted so as to form parts, Q and S; fig. 2. A similar short piece of stiff copper wire T is attached between the first and second nuts of binding-post P. There is a very short gap between wires Q and T and between S′ and S. These gaps are for protective purposes when one forgets to throw the lightning switch to the grounded side. Another method of protection would be to install a lightning arrester in the antenna system. The arrester may be installed just outside or just inside of the building, preferably the former. This serves as an extra precaution when one forgets to throw the lightning switch to the ground terminal when the receiving set is not being used.

If the condenser is mounted on the receiving set described in Circular No. 121, it may be placed as shown in Fig. 3. In other words, it is mounted upon the vertical board which supports the pri-



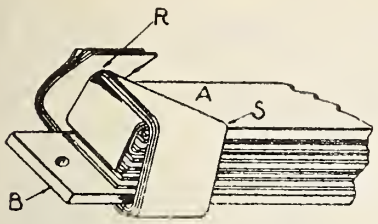


FIG. 5

mary coil tube previously described. The connections from the condenser to the binding-post on the front panel of the two-circuit set are made as described above.

If the connections to the receiving set have been made as described in Circular No. 120 or No. 121, the antenna lead-in wire is removed from the binding-post marked "antenna" and connected to the new binding-post which has been added to the front panel of the receiving set (See P, Figs. 2 and 3). The condenser

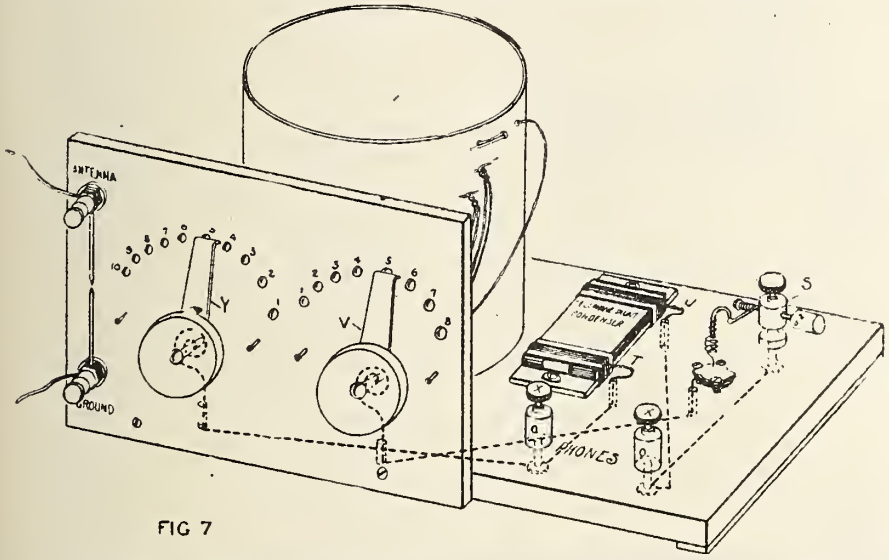


FIG 7

is now included in the electrical circuit together with the tuning coil, between the antenna and ground. This connection to the building-post is used when it is desired to receive wave frequencies of approximately 1,000 kilocycles per second or above (wave lengths of 300 meters or below). To receive wave frequencies of 1,000 kilocycles per second or below (wave lengths of 300 meters or more) the antenna lead-in will ordinarily be connected to the binding-post marked "Antenna" and the operation of the receiving set is then as described in Circular No. 120 or No. 121. In either case the set is tuned to the desired wave frequency in the same manner as described in Circulars No. 120 and No. 121. The switches are set so as to include more turns of wire on the tuning coil (or the primary coil of the two-circuit receiving set) with the antenna lead-in connected to P than when it is connected to the binding-post marked "antenna," when tuning to a given wave frequency....

Telephone-Shunt Condenser.

The parts used in the construction of the telephone-shunt condenser are: a cap piece of heavy pasteboard or wood (A) about 1 3-8 by 3 by 1-8 inches, a similar base of pasteboard or wood (B) 1 3-8 by 3 7-8 by 1-8 inches. 6 pieces of tin foil (C, D, E, F, G, H) 7-8 by 7 inches, 7 pieces paraffined paper or mica (J. K, L, M, N, O, P) 1 1-8 by 3 inches, 1 stiff paper clip or its equivalent (for temporary use), about 10 feet of No. 24 bare copper wire, and 2 round head wood screws about 1-2 inch long. The several steps in the arrangement of these parts are shown in Figs. 4, 5 and 6. The layers of paraffined paper and tinfoil are alternated as shown, starting with a sheet of paraffined paper on the base B. The paper J is placed in the center of B so that there will be a 1-8 inch margin at the sides and 7-16 inch margin at the ends of B. A sheet of tin-foil C is then placed on the paper J so that there will be 1-8 inch of margin of paper uncovered on three sides. The tin-foil C will then extend 4 1-8 inches over the right-hand edge of the paper J, or 3 3-16 inches over the right-hand edge of the base B. The paraffined paper K is placed on C directly above J. The tin-foil D is placed on K. The overhanging end of D extends to the left instead of the right as did C. The other three sides of D are 1-8 inch in from the three edges of K. This arrangement of alternate layers is followed until the seven paraffined papers and the six sheets of tin-foil are placed in position. The cap piece A is then placed as shown in Fig 4.

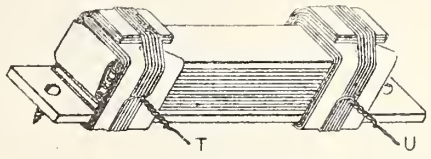


FIG. 6

The condenser now appears as shown in Fig. 4, except that the thickness of the condenser is much exaggerated here in order to better show the parts. A paper clip or other form of temporary clamp may be used to hold the parts firmly together. The tin-foil strips, D, F and H, are now bent back over the end of the cap piece A and folded over at an angle of 45 (see line RS, Fig. 5) so that the tin-foil may be wrapped evenly around the pieces, A and B, and secured by several turns of No. 24 bare copper wire (see Fig. 6). The tin-foil strips, C, E, and G, Fig 4, are wrapped in the same manner. The completed condenser appears about as shown in Fig. 6, except much thinner.

This telephone-shunt condenser just described may be added to the single-circuit receiving set described in Circular No. 120 or to the two-circuit receiving set described in Circular No. 121. The condenser is placed as shown in either Fig. 7 or Fig. 8. A somewhat simpler plan is to screw the condenser to the underside of the receiving set baseboard. This saves drilling more holes in the baseboard in order to keep the wiring on the underside. No matter with which receiving set this condenser is used, the two wires, T and D, (Figs. 7 and 8) are connected to the two telephones receiver binding-posts marked "Phones."

Fixed condensers may be purchased which will give about the same results as those described in this circular. The series-antenna condenser has a rated capacity of about 0.0003 microfarad (300 micromicrofarads). The telephone-

(*Continued on page 30.*)

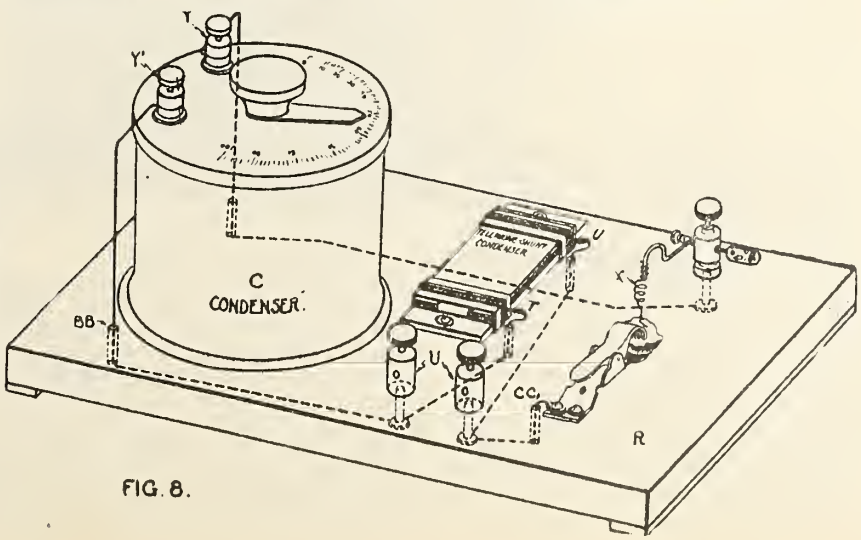


FIG. 8.

Description of a Loading Coil Used With Simple Radio Receiving Sets

By the U. S. Bureau of Standards

Introduction.

THIS circular describes a loading coil which is used in conjunction with the single-circuit radio receiving set described in Bureau of Standards Circular, No. 120. The experimenter who is interested in using it in connection with the two-circuit set described in Circular No. 121 is referred to the section entitled, "Use with Two-Circuit Set," near end of this paper.

The purpose of the loading coil is to enable the receiving equipment to respond to wave frequencies between 100 and 500 kilocycles per second (that is, wave lengths between 3,000 and 600 meters). In other words, the loading coil increases the wave frequency (wave length) range of the receiving set. The receiving set described in Bureau of Standards Circular, No. 120, has a wave frequency (wave length) range of between 500 and 1,500 kilocycles per second (wave lengths between 600 and 200 meters).

The use of the loading coil will increase the receiving distance of the equipment, because many stations using the lower wave frequencies (longer wave lengths) use a high-power radio transmitting set. For example, the station, NAA, at Arlington, Va., uses a wave frequency of about 113 kilocycles per second (2,650 meters wave length) and uses sufficient power to be heard a distance of about 200 miles when the loading coil described in this circular is used with the receiving equipment previously described. At night this distance may be considerably increased.

The cost of the parts for the loading coil is approximately $3.00.

Description.

A loading coil is simply a coil of wire connected to the rest of the receiving equipment in such a manner that a variable number of its turns are included in the circuit between the antenna and the ground connection. When longer wave lengths (lower wave frequencies) are received, more turns are used on the coil.

The loading coil is shown at A in Figure 1A, and consists of 300 turns (about 5 ounces) of No. 28 double-cotton-covered copper wire wound on a round cardboard box 5 3-8 inches in diameter by about 8 inches long. An oatmeal box is used for the cardboard tube with the cardboard cover glued to one end. Certain of the turns are provided with taps which are connected to switch contacts so that the number of turns included in the circuit can be varied. One end of the wire is fastened at the closed end of the tube by weavng it through two holes 1-2 inch apart and 3-4 inch from the end. The free end of the wire projects about 10 inches. The wire is wound on the tube in a single layer so that the turns lie closely and evenly together. When 10 turns have been wound, a 10 inch tap is taken off. After the given number of turns of wire have been wound on the tubes a hole is punched through the tube just underneath the last turn and, by using a small blunt tool or stick, a 10-inch loop of the wire is pushed through this hole. A second hole is punched through the tube about one-half inch farther along the circumference and the loop pushed through this hole to the outside of the tube again. The loop may or may not be twisted as it emerges from the second hole. See Fig. 1B. When 10 more turns have been wound, another tap is taken off in the same manner. The arrangement of these taps is shown in the left half of Fig 1A. It will be noticed that there are 13 taps on the completed coil, counting the two ends of the wire at the start and finish. Each tap is slightly offset from the preceding one so that the line of completed taps progresses about half way around the coil as indicated in Fig. 1A. After the wire is wound on the cardboard tube or oatmeal box it is placed in a warm oven to drive off the absorbed moisture. After the tube has dried for some time and while still warm, melted paraffin is brushed over the tube, inside and out. The paraffined tube is put back in the oven for a few minutes in order to more thoroughly impregnate the tube.

The switch panel B is made from a piece of dry wood about 7 inches long, 4 1-2 inches wide and 1-2 inch thick. Its general construction is similar to the switch panels described in Circulars Nos. 120 and 121. The two switch arms, C and D, which are used with this panel have also been described in Circular No. 120. Having drilled the holes for the two switcharm bolts, the switch arms are placed in position and the knobs rotated in such a manner that the ends of the contact arms describe arcs upon which the contact points are to be placed. The holes for the switch contact bolts are then drilled; the spacing between contacts depending upon the width of the end of the switch arms, as well as upon the kind of contacts which are used. For the switch arm C there are 11 contacts and for the switch arm D, 3, as shown. The wood base E is a block of wood about 7 inches square and 3-4 inch thick.

Assembly and Wiring.

Before any of the parts are assembled the base and panel are treated with paraffin or they may be thoroughly dried and coated with a good grade of varnish which will not absorb moisture. Shellac is not used. The panel B is fastened to the base E and the coil A is placed in position so that the row of taps faces the rear of the panel. The coil is fastened in this position by small wood screws passing through the cardboard end, each screw being provided with a washer. The two switch arms with the necessary contact bolts are placed in position on the panel. A wire connection is made between switch arm D and binding post H and between switch arm C and binding post I as explained in Circular No. 120, or a spring washer is slipped over each switch-arm bolt at the rear of the panel and the wires soldered to these. See Fig. 1C. The several taps from the coil are cut off to a length sufficient to reach from the coil to the contacts. The insulation is scraped from the ends of the wires and the ends of the double taps twisted together below the point G, Fig 1A. The taps are fastened between the nuts and washers of the proper contact bolts as shown in the left half of Fig. 1A.

This leading coil is used in connection with the receiving set described in Circular No. 120. The method of making the connections is shown in Fig. 1A. A 10-inch copper wire with a battery clip at one end is fastened to the binding post H with the clip attached to the receiving set binding post marked "antenna." The wire originally leading from the back of the antenna binding post was connected to the back of the switch arm bolt V. The wire is removed from the back of the antenna binding post and attached to a new bolt or binding post fastened to the *baseboard* of the simple receiving set. This bolt or binding post is located just at the rear of the receiving set binding post marked "ground." A 10-inch piece of copper wire is attached to this new bolt or binding post with a battery clip attached at the end toward the loading coil binding post I. The wire leading from the crystal to the rear of the antenna binding post, as described in Circular No. 120, remains as it was. If this wire was originally connected as described in Letter Circular, No. 43, or directly to the switch-arm bolt V, it is removed and connected to the rear of the antenna binding post. All other wiring is as described in Circular No. 120.

Method of Operating.

The wire leading to the antenna is connected to the binding post marked "antenna" and the wire leading to the ground is connected to the binding post marked "ground" as before. In order to receive messages transmitted at wave frequencies between 500 and 1,500 kilocycles per second (wave lengths between 600 and 200 meters) the switch arms, C and D, on the leading coil panel, are both set on the contacts marked O. When receiving at the shorter waves (200 to 600 meters), it is better to remove the battery clip from the antenna binding post and put the clip previously attached to I in its place; that is, attach the wire from the new binding post to the antenna binding post. The loading coil

(*Continued on page 30.*)

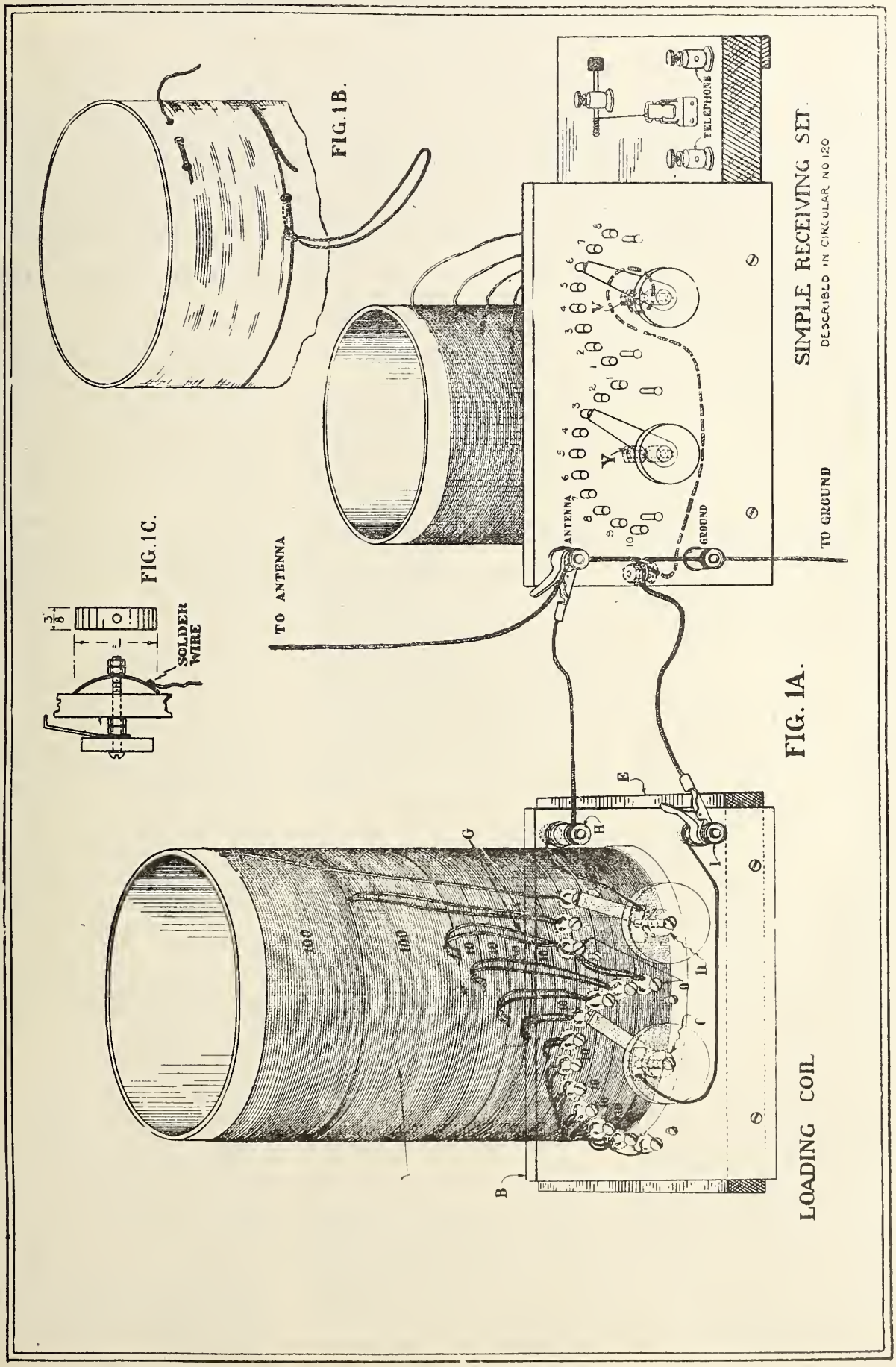


FIG. 1A.
SIMPLE RECEIVING SET
DESCRIBED IN CIRCULAR NO 120
TELEPHONE
ANTENNA
GROUND
TO ANTENNA
TO GROUND
FIG. 1B.
FIG. 1C.
SOLDER WIRE
LOADING COIL
B
C
E
F
G
H
I
L
100

Here's That Lawsuit Against Grebe

MERELY a reference in the December issue of this magazine to the suit brought by the Radio Corporation of America against the A. H. Grebe Company has brought correspondence from far and near. When we went to press on the last number we had little information concerning the suit and expressed a desire for more. Various radio manufacturers and dealers have forwarded us copies of a pamphlet containing the text of the bill for injunction filed by the Radio Corporation. The front cover of this pamphlet bears th. legend "What Do YOU Think of This?" This pamphlet apparently has been widely distributed on the supposition that the radio public will want to get the details.

There is enough jaw-breaking legal phraseology in the Radio Corporation's bill to put a Philadelphia lawyer fast asleep. In every-day, street-corner English the bill asks that the Grebe people be enjoined from making receiving sets which are intended to be operated with a certain sort of detector and amplifying tubes of which the Radio Corporation claims to possess all existing patents.

The Corporation also asks the court to order the Grebe people to turn over to the Corporation all of the apparatus they have in stock, built in alleged infringement of the bigger company's rights. As an alternative it is suggested that the court take possession of the receiving sets, etc., to do with them as the court may see fit. A third suggestion is that all this equipment be mashed and smashed and splashed until it bears no resemblance to anything that might be sold, leased, manufactured, supplied or installed by the Radio Corporation, proceeding under its alleged rights under the patents owned by the Corporation.

The bill names J. H. Bunnell, Inc., as co-defendant with A. H. Grebe & Co., Inc. The Bunnell concern is a distributing company, it is set forth. The bill relates that our old friend, Lee DeForest, in 1916 applied for patent rights on "Devices for Amplifying Feeble Electric Currents" and that in 1907 our old radio friend Lee came right back with application for patent rights on certain new and useful improvements in "Space Telegraphy." Letters of patent were issued to Brother DeForest in due time. Along in 1917 said DeForest sold the patents to the American Telephone and Telegraph company.

The American Tel. and Tel. sold the whole shooting match to the Radio Corporation as late as November 9, 1922. This sale included the right to sue for recovery of damages, profits and savings. The Corporation's bill relates that there had previously been litigation over these patents and that a certain Elman B. Meyers, of California, had been whipped in a court skirmish and that one Jacob Hohenstein, of New York, also had permitted himself to get on the losing end of a temporary injunction "restraining the infringement of said claims."

The most interesting section of the bill relates that Grebe and Bunnell have been making and selling *"wireless receiving sets adapted, designed and intended for use in combination with, and useful only in combination with vacuum detector and amplifier tubes embodying and employing the inventions and improvements of said Letters Latent."*

If the foregoing paragraph means that the Radio Corporation will try to maintain that a manufacturer has no right to build and sell a receiving set into which the purchaser is expected to screw tubes invented and improved by our aforesaid Old Friend DeForest and bought from the corner radio shop, then the radio receiving set manufacturers sure are going to sit up and take notice of the result of the Corporation's prayer.

The Radio Corporation files another bill of complaint of the same character against the same defendants, with the exception that Fritz Lowenstein and not the said DeForest, is named as the original patentee of devices now controlled by the Corporation. The bill says that Fritz "being then a citizen of the United States" was the inventor of certain useful and new improvements in "Telephone-Relays" Fritz sold his rights in this new and useful improvement to the same Telephone and Telegraph company that took over our Old Friend DeForest's devices.

The bill then relates that Robert C. Mathes became in 1916 the inventor of a "Circuit for Electron-Discharge Devices" which he soon sold to the Western Electric Company. The Western Electric Company then sold the patent rights to the several times aforesaid American Telegraph and Telephone company and the Tel. and Tel. then sold the stuff to the Radio Corporation of America. That left the Corporation in sole possession of the Mathes and Lowenstein patent rights and the Corporation wants the court to enjoin Bunnell and Grebe from making and vending apparatus which embodies or employes these inventions.

It is the contention of the Grebe company that the Radio Corporation contemplates a monopoly.

Manufacturers Organize

What is described as a tremendous step forward in the clearing of patent entanglements and manufacturer's patent problems is the announcement today of the formation of an incorporated group, termed the "Independent Radio Manufacturers," with offices at 165 Broadway New York.

In an interview, Mr. Walter Russ, of Pennie, Davis, Marvin & Edmonds, attorneys for the group, declared it to be his opinion that the incorporation of the Independent Radio Manufacturers, Inc., marks the first important step forward in the clearing of the atmosphere surrounding the many patents and counter-patents clouding the radio horizon today.

"At the request of a number of important radio manufacturing concerns," said Mr. Russ, "The Independent Radio Manufacturers, Inc., was organized to join various radio interests into a common cause, for defense or offense in connection with the radio patent situation. Stock is held in equal shares by all the members and the cause of one becomes the cause of all.

"Of course, any action by the group is subject first to the approval of the board of directors, and it is very likely," continued Mr. Russ," that in the event of patent dispute between members of the organization, such differences could in all probability, be arbitrated, or some other friendly settlement arrived at.

"The advantages of concerted action are not limited to the division of expense, alone," stated Mr. Russ. "For example, the radio engineering talent represented by the various members of the Independent Radio Manufacturers, Inc., is such that much more technical data on the history of various inventions and important anticipatory material is available, to the group in a manner which would be possible in no other way. This information may at any time prove invaluable to some one member in need."

When inquiry was made in regard to new members joining the group, Mr. Russ stated that many new names have been submitted to membership accepted and will, in all probability, be acted upon in the near future. Many manufacturers of radio apparatus, learning of the real advantages to the entire industry offered by the Independent Radio Manufacturers are desirous of joining.

"Hooverising Radio"--Legislation Urgently Needed

By CARL H. BUTMAN

THE extension of the regulatory powers of the Department of Commerce over radio is imperative, Secretary Hoover, who has become a sort of foster-father to radio, states in his annual report. Otherwise the development of radio art will be greatly retarded, he explains. The sudden increase of radio telephone broadcasting during the last seven months of the fiscal year from 5 to 382 transmitting stations, and the increase from about 200,000 to 1,500,000 receiving stations, resulted in so much "interference" between sending stations the Secretary of Commerce reports, that the destruction of the usefulness of this very important invention was threatened.

A conference of experts, manufacturers, and government, public and amateur representatives, which was called by Mr. Hoover in February, unanimously recommended the immediate extension of the regulatory powers of the Government and drafted a set of technical provisions for submission to Congress.

Identical radio bills were introduced in the two houses of Congress last session by Senator Kellogg and Rep. White, but they are apparently "pigeon-holed," awaiting, perhaps, the demand of the radio public itself before any action will be taken. Department of Commerce officials handling radio matters have cherished the hope that early action would be forthcoming for some time and continued to license all broadcasters every three months, while awaiting a definite law. New legislation would aid the Secretary of Commerce in enforcing the laws and bring about a more satisfactory condition for both operators and "fans," they point out. Authority for the appointment of the advisory committee of six Governmental and six outside civilian members, would assist the Secretary in reassigning definite wave lengths and in the allotment of more bands for commercial and private uses. Congressman White's bill is expected to be pushed but action is not assured this session.

Recommendations of the Radio Conference were for one exclusive Governmental broadcasting wave band, two bands for private and toll broadcasting, and four for use by both Government and private broadcasters, which would give such transmitting stations broader scope and prevent interference to a great degree. Today only two public broadcasting waves are available, 360 and 400 meters, while the Government wave is 485, confining a very large amount of matter broadcast by many stations to only three wave lengths, and necessitating time schedules and silent periods. The assignment of waves under these recommendations, as well as other technical problems, would devolve upon the advisory committee. It is very likely that Secretary Hoover would secure the aid of the present Interdepartmental Radio Committee, or at least six of these technical experts as the Governmental representatives on his new committee.

Another feature planned if new legislation is secured is to make the wave band between 600 and 1,600 meters, now assigned for Governmental use, available to commercial and public stations. Details such as these, however, it is hoped will be left to the discretion of the Secretary. The art of radio is developing so rapidly as to demand constant changes and the permanent or specific designation of every wave or band of waves by law would be a hindrance.

Interference is actually far worse today than it was five months ago, when Mr. Hoover's report closed at the end of the fiscal year. Instead of there being 382 broadcasting stations on 360 and 400 meters, there were actually 565 such stations in operation on December 1, or 179 more than existed on June 30. During the fiscal year seven commercial trans-atlantic stations were placed in operation, providing for better communication with Great Britain, France, Italy, Japan, Norway, Poland and Germany. Another commercial station opened for business with Central America and plans for circuits to South America and China were also underway. In the fiscal year ending June 30, 1922, commercial land stations, excluding broadcasters, increased from 161 to 345.

Amateur station licenses increased from 10,809 to 15,504 between June 30, 1921, and June 30, 1922. In the past five months, however, 1,304 more stations have been licensed bringing the total amateur sending stations to 16,888 on December 1. The increase in amateur interest by 5,999 is gratifying to the officials of the Government, for they say, these young men constitute a reserve of trained operators, some of whom have already contributed to radio art. During the war many amateurs were found to be superior to the average commercial operator in resourcefulness and technical knowledge.

The necessity of an international conference on radio communication for the adjustment of international

(*Continued on page 28.*)

Button—Button Who's Got the Button?

THE old game of "Button, Button, Who's Got the Button?" has just been applied to radio broadcasting, and when the younger radio "fry," meet they ask each other how many radio buttons they have, the one with the greater number being the winner. Several stations now have individual buttons and many have their orders on file.

W. Dandridge Terrell, Jr., fourteen year old son of the Chief Radio Inspector, of the Department of Commerce, is the "inventor" and owner of the new radio button scheme. He is supplying broadcasting stations with identifying buttons of different colors bearing their name, call and sometimes their slogan. Distribution of the buttons is made by the stations to listeners-in who report having received their broadcasts.

Many fans are already pridefully displaying the buttons of their favorite stations on their coat lapels or on banners hung on the wall over their receiving sets. Those possessing the most buttons are local champions. As new broadcasters adopt buttons, the scope of the game increases and there are more buttons added to the pennants of the receiving stations. A prize pennant is planned for the receiver securing the most buttons in a given time.

The young inventor who is a pupil in the Force School in Washington, is believed to have started something new in the way of advertising and both broadcasting stations and fans are enthusiastic over the plan. Among the first stations to adopt buttons were "WSB," the Atlanta Journal, and "WFAA" The Dallas News.

With the Radio Trade

Courts Sustain Injunction

The Appellate Division of the Supreme Court of the State of New York has recently confirmed the lower court's decision granting an injunction to the Freed-Eisemann Radio Corporation in their suit against the Wireless Specialty Apparatus Co. The injunction was sought to prevent the Wireless Specialty Apparatus Company from advertising and circularizing certain statements made in regard to radio patents.

This decision has a very important bearing, and is the first step in the solution of a great many patent tangles resulting from the sudden growth of this latest "infant" industry.

Interesting developments are now expected as a result of this decision, in connection with the claim of Freed Eisemann Radio Corporation for $150,000 damages, alleged to have been suffered by them as a result of the patent warning advertisements inserted in various papers, and in restraint of which the injunction was granted.

Let's Name It "Radio!"

With nearly every new development of great popular interest there comes an era of using the new name for practically anything—and so a literal flood of articles have been christened "Radio." Some objects are aptly named, but many of them have nothing to do with the art or practice of wireless telegraphy or telephony.

Twenty-four articles use the single word "Radio" as a trade mark, according to the Patent Office records, and more applications are on file. The first use appears to have been in connection with a chemical compound registered by John B. Daniels on August 23, 1904, about six years before the Navy adapted the word to wireless telegraphy.

In 1911 the word "Radio" was registered as a trade mark for a make of hot-air fans and also a brand of varnish and paint. The type and design of the letters in the word of course were different, and sometimes the background varied. In 1913 and 1914, "Radio" was employed to designate certain forms of chemicals, medicines, insecticides, leather, threads and yarns, and furniture polish.

What was probably the first registeration of this trade word for an electrical contrivance was taken out for electrical batteries and apparatus early in 1915. A little later came a type of "Radio" ball bearing, and in 1918 the "Radio" golf ball was trade marked. A non-intoxicating beverage took on the name in 1918, and in the next two years it was used to designate certain flower and garden seeds, auto lenses, phonographs, tires, and a brand of canned fish. The past two years saw "Radio" applied to watch charms, writing paper, skirt braid, playing cards, cigarettes and dyes.

It was March 14, 1922, before a piece of wireless apparatus was trade marked with "Radio," although before then it had been combined with other words to designate many things. Silk, pens, tonics, a magazine, and tea had been branded with the mystic letters. Both "radiofone" and "radiophone" were used in 1920, and 1922 came "super-Radio" and "Radio Rex."

Many articles bear the name which seem not to be trade marked, among them the recently advertised "Radio Boot," "on and off in a flash," and radio overcoat, with weather resisting qualities has also appeared. The other day the name was assigned to a ship, which curiously carries no wireless apparatus. In the field of sport the name has been appended to a race horse and "wireless," another horse is also pretty well known. Apparently "Radio" is a popular name, taken by and large, for use in any field, but there are those who would like to see to see it confined to matters connected, at least, with the art.

Pittsburgh's Show

A sparkling, scintillating electric fountain, a complete electric home, a wedding by radio, and the hall jammed with thousands of people, other thousands being turned away at the door, all contributed to making the recent electrical exposition, held under the auspices of the Electric League of Pittsburgh, a complete success. It was stated by electrical men that this show was one of the best ever attempted in the United States. During the week that it was held, the main topic of conversation in Pittsburgh and vicinity was the electric show and everyone, not seeing it, was made to feel that a great deal was missed.

The indescribably beautiful electrical fountain, designed by W. D'Arcy Ryan, was one of the world's most dazzling lighting effects. Myriads of multi-colored spectra flashed about the hall, the central water spout shot up with a rush, and the 20,000 jewels flashed, glittered and sparkled from the central beams of sixteen powerful searchlights and a multitude of smaller lights.

The $40,000 house, completely erected in ten days, with real grass growing in an iron-fenced lawn outside, was something that is not ordinarily seen indoors. The house consisted of five rooms, a bath and a reception hall, each perfectly equipped, with all the latest in furnishings and every conceivable electrical appliance. The house was broken in two so that the crowds could walk between it and so have an unobstructed view into the rooms.

Radiophone loud speakers were stationed at strategic points about the hall and the address of A. W. Thompson, president, Philadelphia Company; E. M. Herr, president, Wstinghouse Electric & Manufacturing Company; A. M. Lynn, president, West Penn Power Company; K. I. McCahill, president, Pittsburgh Harmony, Butler and New Castle Railroad. W. M. Furey, president, Pittsburgh Chamber of Commerce, could be heard and, at the same time, by reason of their speaking from a glass booth in the hall, the speakers could be seen by all attending the show. The words of these men were transmitted to the Westinghouse Radio Station, KDKA, at East Pittsburgh from where they were broadcast. A wedding was held in this booth and that night over 5,000 persons were turned away from the door.

Lighthouse Keepers' Club

Several men in the Lighthouse Bureau at Washington have been dabbling with radiotelephone receiving sets, and it has occurred to them that their experience would be valuable to keepers and other members of the service who would like to enjoy the pleasures of the radio concerts. Therefore, they propose to organize a radio club among the amateur "fans" of the service. The initiation fee will be a postal or letter stating approval of the scheme and a desire to be enrolled as a member. The dues will be a word or two from time to time telling of difficulties encountered, results secured, or asking information.

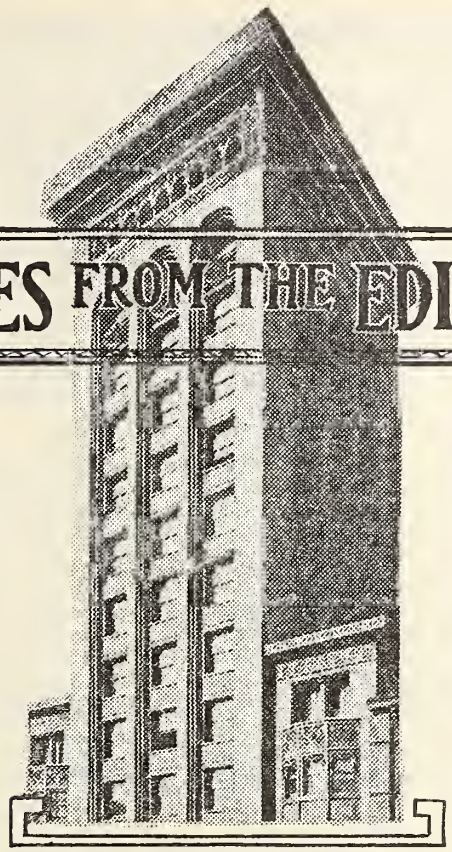
A space in the Lighthouse Service Bulletin will be reserved for answers to questions and interesting information as will enable them to construct their own sets or improve those they already have and to conduct a clearing house for new ideas. Articles will appear from time to time on different phases of the subject. Charles C. Brush is in charge of the plan.

Government List Ready

"Amateur Radio Stations of the United States, edition of June 30, 1922," is ready for distribution according to the Department of Commerce. Applications should be made to the Superintendent of Documents, Government Printing Office, the price is twenty-five cents. The publication contains 300 pages and records 15,504 amateurs licensed up to June 30, 1922, their calls, address and power together with special licenses issued to training schools and experimenters.

6,500 Mile Record

An unusual combination of atmospheric conditions is believed to have made possible a radio feat recently reported. According to the report the wireless station at Eastevan, 150 miles southwest of Victoria, B. C., on Sept. 21 spoke to an operator at Raratonga, N. Z., 6,500 miles away.



THOUGHT WAVES FROM THE EDITORIAL TOWER

SHALL broadcasting be controlled by the few? It is a question exactly as big as radio. There is sufficient evidence that the Westinghouse Electric and Manufacturing Company, associated with the Radio Corporation of America, would like to eliminate all broadcasting stations not owned or controlled by the Westinghouse interests. The argument of General James G. Harbord, published elsewhere in this issue, is that if wave lengths and locations of stations were properly allocated there would be room for only forty-six big broadcasting stations in the United States. It is General Harbord's view that by decreasing the number of stations from about six hundred to forty-six stations, interference would be eliminated, programs would be of more excellent quality and "the greatest good to the greatest number" would be accomplished. Similar views have been expressed by officers of the Westinghouse Company, notably by Mr. Davis.

But in the motive of the Radio Big Four (General Electric Company, United Fruit Company, Westinghouse Companies and the American Telegraph and Telephone Company) altogether altruistic? Is there a perfectly natural hope in the heart that, with broadcasting under their control, these giant corporations could vastly increase the sale of their Radio Corporation apparatus?

Secretary Hoover, of the Department of Commerce, is among those who predict that owners of receiving sets in the United States will soon number millions. Do our radio citizens want the vast influence, soon to be exerted on our social and economic life by radio communication, controlled by a group of corporations?

Is not radio broadcasting, with its direct contact with all the people, best left in the control of individual companies, of various political, sectional and business perferments? Is not radio broadcasting to have the same American freedom as has the daily newspaper?

Owing to mechanical difficulties it is necessary to combine the January ond February issues of Radio Age in this issue. Schedules in both the subscription and advertising departments will be adjusted accordingly so that subscribers or advertisers shall receive full value on all contracts.

It is argued that independent broadcasters cannot go on supporting stations at an expense of from $25,000 to $50,000 a year. Many of them are in a position to do so and as long as they are willing to pay the fiddler who has the right to stop their dance?

We would like to see broadcasting conducted on a free-for-all enthusiastically competitive basis, of course with reasonable government restrictions as to interference, and as to character of broadcast programs.

Our broadcasting is all right; our broadcasters are all right. The radio fans will testify to it. What radio needs now is some action in Washington to end the present impossible wave-length overlapping, thereby giving broadcasters and fans the use of the air—to which they are entitled.

And if radio communication is to be monopolized let us at least make it a government monopoly. Wireless is too universal in its appeal, in its possibilities for good, in its power to reach the masses to pass from the possessive control of the American people.

RADIO is beginning to find its place in crime detection and tracing of fugitives. It was obvious from the start of broadcasting that the use of wireless could not fail to be of benefit to the police of cities and law enforcers generally.

A striking example of the use of radio in this way is presented by the search for the robbers who got away with $200,000 from a federal reserve truck in Denver in front of the United States mint. Serial numbers of the bank notes stolen were at once broadcast by Denver stations and the whole country was instantly apprised of the description of the loot and of the robbers.

With a million and half persons listening in it is difficult to conceive of a more effective way of hampering a criminal's flight and making it difficult for him to dispose of his plunder. When the final chapter of this Denver robbery is written we predict that it will be found that crystal detectors or vacuum tubes had a good deal to do with the solution of it.

FRANK D. PEARNE, technical editor of Radio Age, has received the following letter which is published in the belief that some reader may want to lend a radio hand to the convicts at the state penitentiary at Joliet, Ill.:

"My dear Mr. Pearne:

"Noticing your articles from time to time on "Radio," I have intended to write you with reference to getting information, etc., as to a receiving set. I am therefore taking that liberty now.

"I have been on the State Honor Farm for over two years now, and that occasions this letter. There are on the average, one hundred and twenty-five men here. We are two and a half miles west of

Lockport and about forty miles from Chicago. Being short on entertainment, if there is any way we can install the equipment for a receiving set so that we could have the benefit of the fine concerts, lectures, as well as many other things coming over the air, it would be a great boon to us.

"I would like to get you interested for it is a worthy cause, so to speak—and to have you give us advice, and if agreeable, lend your aid, so we could get the proper equipment at as low a price as possible.

"Under the present administration of affairs here, with Acting Warden John L. Whitman in charge, everything possible is being done to have the men realize that they *are* men, and that they *are* expected to go out and prove it by making good. It is easy to see therefore, what *great* good a radio set would do here.

"We have a dining hall, about 16x50, where the apparatus could be placed so the concerts, etc. could be heard. We have electricity, power furnished by the Sanitary District. Just what information you would want before giving us suggestions, as to what we would need, I do not know, but if you will give us an idea as to about what would be necessary, its probable cost, etc., I will be grateful."

Bank Operates Giant Radio

The most powerful radio broadcasting station on the Pacific Coast—and one of the most powerful in the United States—is now "on the air" in regular service on "Telegraph Hill," San Francisco.

The station — officially known as KFDB—was established by the Mercantile Trust Company of California, and is the first in the West to be built, owned and operated by a bank.

KFDB has a sufficient range to reach all points west of the Rocky Mountains. It is broadcasting every day (Sunday excepted) commercial, financial and agricultural information between the hours of 10 and 11 a. m., 2 to 3 p. m., with a musical program between 9 and 10 p. m.

The first attempt at broadcasting from the KFDB station—made in August—developed an interesting problem in radio engineering. The power was supplied direct from a 2,000 volt generator, but the commutator hum of the generator prevented satisfactory radio reception.

To eliminate this disturbing noise, it was decided to install a 2,000 volt 20 amphere hour storage battery, and use the generator for recharging the battery in series. The Philadelphia Storage Battery Company supplied 333 Philco Radio "A" Batteries for the purpose and regular broadcasting was started on November 1.

Broadcaster Saves $56,000

ONE broadcasting station has been issuing for some months its weekly program to 30,000 "listeners-in." This has been mailed at great expense. The station has decided not to continue this method and we publish a letter the station issued a month ago, eliminating the name of the station for the reason that we have not received permission to use it. The letter comes to us from a fan who says the decision is "somewhat of a calamity," as having the program at hand assists in identifying the station.

The broadcaster's letter follows:

"Dear Friend:

"This station has been vitally interested in the constructive side of radio transmitting. With this issue before us we are going to change one thing to better develop the other.

"We have been publishing a weekly program; our mailing list on this program has now passed the thirty thousand mark. We estimate that if continued, it would cost us fifty-six thousand dollars per year to print, addressograph, and mail this program. This overhead expense in no manner improves the character or quality of our broadcast program, which is really 'the constructive side of radio transmitting.'

"You do not listen in on the printed leaflet. It merely gives you the names of persons, selections, hours of broadcasting, etc. We believe there is a better way, at a very great saving to us, allowing us to put this saving into better radio transmitting, which is again 'the constructive side of radio transmitting.'

"The station issues a weekly newspaper advance program sheet which is mailed the newspapers free. If your newspaper prints this daily or weekly, you get the names, numbers and hours just as well as though we sent it to you individually. A one-cent stamp takes it to the newspaper; the newspaper passes it on to thousands of listeners at no further expense to anyone, whereas it now costs four cents each week to reach each person in the thirty thousand. In order to get 'the constructive side of radio transmitting' to all the listeners in your territory, we ask that you make it your individual duty to cooperate with us on this change, thus saving us a tremendous expense and accomplishing the same end in another way. It will be put to you to see that your newspaper is placed on our newspaper program mailing list. It will also be up to you to see that this program is being published daily or weekly for the benefit of yourself and everyone interested, in your territory. The amount of public demand for this service will determine your newspaper's willingness to give space for the purpose. The cooperation of yourself and other listeners in your district with the newspapers in your locality is therefore necessary

"For reasons which are obvious, it will be *necessary that the request to be placed on this list must come from the newspaper direct.*

"This station will continue with the very best programs, ever striving to improve the quality of its service to the public. It is obvious that the elimination of this one overhead expense and concentration of our savings and efforts upon the quality of our broadcast programs can only result in the improvement of that product.

"Your correspondence is solicited, now as before. Your criticisms, suggestions, and advice have helped us materially in placing our station acehigh among the broadcasting stations of the country. We need your further cooperation to further improve our service.

Very sincerely yours,

"P. S.—The program enclosed herewith will be the last copy issued to individual listeners."

Organ Recitals

Through the courtesy of the Estey Organ Company, the Radio Corporation-Westinghouse station, WJZ, Newark, N. J., has arranged to broadcast organ recitals at least twice a week during the coming winter.

The organ, because of its extreme purity of tone and great versatility, has always been the most popular of musical instruments, and the radio audience has voiced its approval of the recitals now being broadcasted by several of the larger stations. Unfortunately, however, the average organ is not well adapted for radio purposes. For both structural and artistic reasons, it is installed in several different sections; and though the player can produce beautiful effects for his immediate audience by the appropriate use of these different sections, the variation in the volume of sound is too extreme to be entirely satisfactory to the radio audience.

The engineers of WJZ studied all of the available organs with this fact in view and were delighted to find in the great Estey organ, installed in the general offices of the company at 11 West 49th Street, New York City, one that was not only of the highest musical excellence but that also seemed especially designed for radio purposes. In this organ, the sound chambers are so arranged that all of the tone emerges from a single point, regardless of which banks of pipes are being played. This greatly simplifies the transmitting problem and permits every sound intensity to be caught at its true relative value by the microphone.

An unusual feature broadcast by WJAX, the radio station of the Union Trust Company, Cleveland, was the organ recital by Edwin Arthur Kraft, at the new Cleveland Public Auditorium on Tuesday evening, November 28.

This program was of especial interest to radio fans because of the unusual character of the organ upon which the recital was played. The Cleveland Public Auditorium organ is the largest in volume of any organ in the world and has been the cause of much interest upon the part of musicians as well as much curiosity upon the part of the public. The organ was designed and built by the Skinner Organ Company of Boston, Mass.

The Monthly Service Bulletin of the

NATIONAL BROADCASTERS' LEAGUE

Solely by, of and for Radio Broadcasting Station Owners

George S. Walker
Western Radio Corporation
Denver, Col.
President

Arthur E. Ford, E. E.
State University of Iowa
First Vice President

W. J. Baldwin, W S Y
Alabama Power Co.
Birmingham, Ala.
Second Vice President

Frederick A. Smith
Garrick Building,
Chicago
Secretary

Founded to promote the best interest of Radio Broadcasting stations in the United States and Canada.

Executive Offices, Garrick Building, Chicago, Ill.

DIRECTORS:

T. B. Hatfield, W O H
President Hatfield Electric Co.
Indianapolis, Ind.

S. W. Place, W B A G
Radio Engineer,
Diamond State Fibre Co.
Bridgeport, Pa.

T. W. Findley, W L A G
President and Genl. Mgr
Findley Electric Co.
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New Haven, Conn.

Earle C. Anthony, K F I
Earle C. Anthony, Inc.
Los Angeles, Cal.

Howard E. Campbell, W W J
The Detroit News,
Detroit, Mich.

A. J. Westland, W W L
Physics Dept. Loyola University
New Orleans, La.

J. Elliott Jenkins, W D A P
Midwest Radio Central, Inc.
Drake Hotel, Chicago, Ill.

H. A. Trask, K S D
St. Louis Post Dispatch
St. Louis, Mo.

Frank W. Elliott, W O C
Palmer School of Chiropractic
Davenport, Ia.

President George S. Walker, of the National Broadcasters' League, sent out a call for a convention of the league to take place on January 16, but notices were mailed later informing broadcasters that the meeting had been deferred because of the postponement of the Second National Radio Exposition which was to have been held in Chicago from the 13th to the 20th of January.

It was felt that if a meeting were called during the show many broadcasters could be present as attendants at both functions. A meeting will be held at a later date, and information concerning it will be forwarded to the membership at the earliest moment after the date is set.

New members of the League since the last issue are reported as follows:

Kelley-Duluth Company, Duluth, Minn.; Lennig Bros. & Co., Ninth and Spring Garden streets, Philadelphia, Pa.; Gene Huse, Norfolk Daily News, Norfolk, Neb.; Standard Radio Equipment Co., Fort Dodge, Iowa; D. W. May, Inc., 375 Central Ave., Newark, N. J.; H. J. Paar, 144 Second Avenue, East, Cedar Rapids, Ia.; Chicago Daily News, Chicago, Ill.; Fort Worth Star Telegram, Fort Worth, Texas.

As we were going to press others were coming in through the mail and will be mentioned in the February issue. All these new members are interested in the possibilities of concerted action.

The Secretary has received a letter from the Radio Broadcasting Society of America, in which the following word of cheer is included:

"We are pleased to see that a good, live Broadcasters' League is being developed in the Middle West and wish you all success."

The Copyright "Hold-up"

THE Secretary of the League has received numerous communications regarding the demand of the American Society of Composers, Authors and Publishers, that the owners of copyrighted music be paid a fee by those who broadcast their music, literature and songs.

The majority of broadcasters appear to believe that the American Society of C. A. and P. is out to gouge the broadcaster. At a recent conference in New York, details of which are found elsewhere in this number, the A. S. C. A. P. was plainly told that its demands would not be met by some of the more important broadcasting interests.

Among those who have been discussing the question with the A. S. C. A. P. is Mr. George S. Walker, President of the National Broadcasters' League. Following is a portion of a letter which Mr. Walker addressed to the society in response to the society's elaborate questionnaire:

"The broadcasting of popular song and instrumental music, and reference to same by the broadcasters in naming the music house having these records and music on sale, undoubtedly has gone a long way toward increasing the sales of said sheet music, and records, and in this your society has undoubtedly benefited. You should remember that when a song or instrumental piece is broadcasted, no one can make use of it other than to hear it, and we cannot see for the life of us how your rights under the copyright law are infringed or abridged in any manner. However, as we are neither lawyer, son of a lawyer, or even a relative of a lawyer, we do not assume to say that your lawyers are wrong in their legal opinions. But we do believe that common business horse sense ought to be applied in this situation. We all are trying to recover from the effects of the war; business for none of us is what we would like it to be, and for one concern, set of men or association to deliberately carry out a plan that not only will wreck another industry, but at the same time seriously injure their own, is beyond us.

"However, law is law, and if you have it on your side, it gives you the right and power to drive, and if you elect to drive (broadcasters out of business), then all we can do is submit, take our loss in broadcasting investment and let it go at that. It will be all in a day's work. The results, if unsatisfactory to your interests in the long run, cannot be laid at our door.

"It seems to us that another way out could be found by you, and we venture the suggestion that you could require broadcasting stations to announce the name of the publisher, song writer, composer, etc., before or after the broadcasting of each number, and I believe all broadcasters would be glad to do this; whereas, I think you will find, generally speaking that the broadcasters will resent this present plan of yours as being an attempted holdup, even though it should be shown that you have a legal right to charge for the privilege of using copyrighted pieces.

"In writing as we have we sought to help you rather than antagonize you, and no matter what slant this whole affair may take, we sincerely hope we will retain your friendship, as I wish to assure you now that you have ours."

Important Meeting

THE National Broadcasters' League will be represented at a conference arranged by the Bureau of Standards, United States Department of Commerce, to be held in the Engineering Societies Building, 29 West Thirty-

ninth, New York, on January 12. The purpose of the conference is to discuss the questions:

(1) Shall a formulation of standards for radio apparatus and service (especially broadcasting) be made?

(2) What type of standardization should be initiated; thus what general classes of apparatus or service, or what specific parts should be considered most important to include in such standardization?

As to classes of apparatus: Transmitting apparatus—Complete sets, Parts; Receiving apparatus—Complete sets, Parts (See Appendix I).

As to classes of service: Broadcasting—Primary—radio telegraph, Local—radio telephone; Ship and shore; Aircraft; Point-to-point—Overland, Transoceanic; Amateur; Line radio—On telephone lines, On power-distribution systems.

(3) What features should be covered in formulating standards for radio apparatus?

a. Methods of rating; b. Methods of testing; c. Dimensional standardization— (1) For electrical interchangeability, (2) For mechanical and dimensional uniformity; d. Specifications for general requirements; e. Specifications for purchase; f. Specifications for safety.

(4) Should steps be taken to provide testing facilities?

(5) What procedure shall be recommended for carrying out the conclusions reached by this conference?

(6) What general recommendations should be made to a continuing committee should such a committee be established?

(7) What consideration should be given to related lines of activity?(e. g., standardization of terms and symbols).

Among the organizations which have been invited to attend the conference are the following:

Aeronautical Chamber of Commerce; American Electric Railway Association; American Engineering Standards Committee; American Institute of Electrical Engineers; American Radio Relay League: American Railway Association; American Physical Society; American Telephone & Telegraph Co.; American Society for Testing Materials; American Steamship Owners' Association; Association of Edison Illuminating Companies; Association of Railway Electrical Engineers; Association of Railway and Public Utilities Commissions; Bakelite Corporation; Boy Scouts of America; Chamber of Commerce of U. S.; Charles Williams Stores; Electrical Manufacturers Council—Electrical Manufacturers Club, Electric Power Club, Associated Manufacturers of Electrical Supplies, Radio Apparatus Section; Electrical Supply Jobbers Association; Electrical Testing Laboratories; Federal Specifications Board; Federal Telegraph Co.; General Radio Co.; Institute of Radio Engineers; International Association of Municipal Electricians, Kresge Co., S. S.; Manufacturers Aircraft Association; Montgomery Ward & Co.; National Association of Electrical Contractors and Dealers; National Association of Electrical Inspectors; National Electric Light Association; National Fire Protection Association; National Radio Chamber of Commerce; National Research Council; National Retail Dry Goods Association; New York State Conference of Mayors; Pacific Radio Trade Association; Radio Corporation of America; Sears, Roebuck & Co.; Society for Electrical Development; Tropical Radio Telegraph Co.; Underwriters' Laboratories; U. S. Department of Agriculture; U. S. Department of Commerce; U. S. Navy Department; U. S. Post Office Department; U. S. Shipping Board; U. S. Treasury Department; U. S. War Department; U. S. Independent Telephone Association; Western Association of Electrical Inspectors; Woolworth, F. W. & Co.

Comprehensive report of the action taken at this conference will be published in the bulletin of the National Broadcasters' League in the February number of Radio Age. This is likely to be the most important radio conference since the sessions of last Spring, which also were held under the auspices of the Department of Commerce.

OWNERS of broadcasting station owners who have not yet joined the National Broadcasters' League, may do so by sending their check for the annual membership fee of $10 to Frederick Smith, Secretary, Garrick Building, Chicago.

Membership will entitle broadcasters to periodical information as to developments in connection with broadcasting, intelligence as to steps taken to eliminate the present almost disastrous interference and news of events in any part of the country affecting broadcasting and broadcasting interests. Also members will receive the official organ of the League for one year.

This nominal fee is required for the cost of issuing circulars and handling the large volume of correspondence. You will find it useful to be associated directly with this clearing house for broadcasting information, which is also a protective institution, offensive and defensive.

The Missouri Plan

Recognizing the need for eliminating interferences and duplications of radiophone transmission in this territory, the Missouri Broadcasters' Association has been organized, with Jewell Mayes of Jefferson City as President and Leo Fitzpatrick of Kansas City as Secretary. U. S. Radio Inspector E. R. Bean of the Department of Commerce was present and legalized the new schedules, which went into effect on the morning of November 27, 1922, leaving each station free of interference from other Missouri stations.

The "Missouri Broadcasters' Association" schedules are as follows, 485 meters being used except when otherwise indicated:

The forenoon schedule for each day of the week except Sunday, from eight to 12 o'clock noon, has each period of each hour divided in the same way, namely:

The first 15 *minutes* of each forenoon hour, WOS, the State Marketing Bureau of the Missouri State Board of Agriculture of Jefferson City; for example, from 8:00 to 8:15.

The next 10 *minutes*, WMAJ, Kansas City Drovers Telegram; for example, from 8:15 to 8:25.

The next 15 *minutes*, WHB, Sweeney Automobile School of Kansas City; for example, 8:25 to 8:40.

The next 10 *minutes*, KSD, St. Louis Post-Dispatch; for example, 8:40 to 8:50, KSD as yet does not start until 9:40.

The next 10 *minutes*, WOQ, Western Radio Company of Kansas City; for example, from 8:50 to 9:00.

WDAF, the Kansas City Star, is not in the air before noon.

During the noon hour the schedule is the same as before noon, excepting that WHB will be in the air on 485 meters only from 12:25 to 12:35, going then to 400 meters for the balance of hour. WOQ and KSD have from 12:35 to 1:00 for use on 485 meters as they may see fit.

From 1:00 *to* 2:00 *p. m.*, the schedule runs the same excepting that WOQ is out of the air and WHB sends from 1:25 to 1:40 and 1:50 to 2:00.

At 2 o'clock WOS begins with its usual 15 minutes. WMAJ has the next 15 minutes until 2:30. WHB will be on 400 meters during this hour WOQ is on 485 meters from 2:30 to 3:00.

3:00 *to* 4:00 *p. m.*—WHB, 3 to 3:30; WDAF on 400 meters 3:30 to 4:30.

4:00 *to* 5:00 *p. m.*—KSD, the St. Louis Post-Dispatch.

5:00 *to* 6:00 *p. m.*—WOS, Jefferson City.

6:00 *to* 7:00 *p. m.*—WDF, the Star.

7:00 *to* 8:00 *p. m.*—Western Radio Company WOQ on 485 and Sweeney's WHB on 400 meters.

By an agreed arrangement between the Kansas City broadcasters, the division of time from 12:00 to 3:00 will be varied somewhat on Saturday only.

The night programs of all Missouri stations remain the same as formerly. On Monday, Wednesday and Friday nights WDAF broadcasts on 400 meters and WOS on 360, both beginning at 8 o'clock. WHB broadcasts on 400, Tuesday and Thursday nights, from 8 to 10:30. KSD, each week night, 400 meters, beginning at 8:00. WOQ, Saturday night, 8 to 9, 360 meters.

Sunday—WOQ, 11:00 to 12:00 and 7 to 7:30; WDAF, 4 to 5; WHB, 8:00; WOQ on 360; WDAF and WHB on 400 meters.

Does not this re-arrangement of schedules, eliminating practically all interferences among all Missouri broadcasting stations, make the average receiving set in a Missouri farm home or office worth at least twice as much as it was under the old jangling conflict of radio transmission?

From Missouri State Marketing Association, Bulletin.

Pick-Up Records by Our Readers

Some Crystal Records

A typographical error in the November issue of Radio Age made it appear that George C. Haseltine has picked up a station 6,000 miles distant with a crystal set. The distance, of course, should have been 600 miles. However the mistake was more or less of a blessin disguise. It served to prove that Radio Age has a strong following, for Mr. Haseltine has been flooded with correspondence about the "6,000-mile" performance until he is tired of trying to tell the eager fans how come.

Mr. Haseltine writes the following which will interest all devotees of the crystal:

Fort Stockton, Texas, Dec. 12, 1922.
Editor, Radio Age,
64 West Randolph St., Chicago.
Dear Sir:

In your letter of the 4th inst., you indicated that you would appreciate any more records of long distance reception with a crystal receiver.

Here are a few amateur spark stations that I have heard working this season, using a small loose coupler and the regular crystal hook-up.

Call	Location	Miles Distance	Date
9 DSD	E. Hutchinson, Kas.	573	Nov. 10
9 AQE	Eldorado, Kans.	592	Nov. 7
9 RR	Lawrence, Kans.	703	Dec. 11
9 BMN	Sedalia, Mo.	777	Oct. 28
9 AOJ	Columbia, Mo.	814	Dec. 11
9 NC	*University City, Mo.		Dec. 11
9 MC	Roodhouse, Ill.	823	Nov 1
9 DAY	Canton, Ill.	999	Dec. 11
9 KV	Polo, Ill.	1073	Dec. 11
9 BM	Chicago, Ill.	1147	Nov. 8

*(Not on map.)

It is not the hook-up that makes this possible, for I use nothing but the regular crystal hook-up such as every one knows, (or should know).

It is partly owing to my isolated situation, no interference from trees, buildings, mountains, etc., a well insulated aerial and lead in, with all connections soldered, a first class ground, and using a small loose coupler, properly wound.

It is an error to put too much wire on the primary; I bring in 200 meter stations with only the first 9 or 10 turns of the primary, and 600 meter ships with 21 to 24 turns.

No one can expect to good long distance work with cheap phones and poor crystal. I use ——— phones, or ———

Very truly,
GEO. C. HASELTINE.

Reinartz Excels

Dear Sir:

Some time ago I built a Reinartz set as outlined by you with the exception of using a 43 plate and 23 plate variable condensor instead of 23 and 11 plate, as per your hook up.

Have two steps of amplification and I want to state that I am getting wonderful results with this set.

Have had set in operation for about two months and have brought in some forty different stations.

I would not exchange a Reinartz for a dozen vario-coupler, variometer hook ups.

On Monday, November 13, 1922, brought in the following stations which I claim is some record: WAAF, Chicago; WBU, Chicago; WGY, Schenectady, N. Y.; WEAF, New York, N. Y.; WJZ, Newark, N. J.; KDKA, E. Pittsburgh, Pa.; WGM, Atlanta, Ga.; WSB, Atlanta, Ga.; WWJ, Detroit, Mich.; WCX, Detroit, Mich.; WHB, Kansas City; WGAF, Kansas City, Mo.; KSD, St. Louis, Mo.; WBAP, Star Telegram, Ft. Worth, Texas; WOC, Davenport, Iowa; WLW, Cincinnati, Ohio; WHAS, Louisville, Ky.; WLAP, Louisville, Ky.; WDAP, Chicago; WGAS, Chicago; WMAQ, Chicago; XYW, Chicago.

This list of stations was brought in from 3:30 p. m. to midnight notwithstanding the fact that we received the entire opera "Aida." Would like to have some vario-coupler, variometer "bugs" shoot at this record.

The aerial used in this test is but 7 feet from ground at one end and 20 feet high on other end (which is bad in end).

Sincerely,
W. G. LEHR,
6842 So. Ada St.,
Chicago, Ill.

Hawaii Gets Detroit

A distance record for the reception of a complete program of radio entertainment was established between the Detroit News broadcasting station, WWJ, and the postmaster of Wailuku, Hawaii, November 23.

On that night The Detroit News Orchestra, which was the first radio orchestra in the world, played "Three O'clock in the Morning" in the studio in the News Building at about midnight, and was heard "clearly and distinctly" in the Hawaiian Islands at about 6:30. The sun is that slow between the two points. The distance is figured at approximately 4,400 miles. It would take sound of a cannon five hours and forty-one minutes to travel from Detroit to Hawaii without the aid of electricity—if that big a sound could be made, which is rather impossible.

But the notes of this music on the wings of radio arrived on the beach of Wailuku in about one fiftieth of a second after leaving the antenna atop The News. Thus were contested the flight of time and the extent of space.

The letter received by The News from the Hawaiian postmaster, A. F. Costa, says, "It sure was some sweet music. There were substantiating witnesses." The report from the postmaster tallies with the station log. Mr. Costa heard the whole program of the orchestra without interruption.

The distance record for a single number of an entertainment program is claimed by Station WGY, owned by the General Electric Company at Schenectady, N. Y., on a report received from Hilo, Hawaii, which is about 4,951 miles from Schenectady, when the distance is calculated on the globe. The distance estimated by WGY on the map was 5,200, but this is subject to correction.

London, England, has heard the station at Newark, N. J., (WJZ), and a ship in the harbor at Cherbourg has heard WGY. These distances are about 3,100 miles.

The Detroit News frequently hears from ships in the Pacific—notably the Easterner, which reports that between Australia and Panama on October 13, 1922, it heard a WWJ concert and "greatly appreciated" it at a distance of 3,500 nautical miles, which is 4,030 ordinary miles.

A letter from the operator aboard the ship Eastener tells of hearing The News complete concerts three successive nights Oct. 11, 12 and 13, while en route from New York to Australia. On the last night the ship was 2,500 nautical miles southwest of Panama, in latitude 9 degrees south, longitude 112 degrees west, and a calculated great circle distance of 3,500 nautical miles from Detroit.

Renting Receivers

Relative to the article entitled "Plan to Popularize Radio," published in last month's Radio Age, Mr. E. L. Russell, proprietor of Colfax Battery Service, Colfax, Ill., writes as follows:

Dear Sir:

"In regard to your "Plan to Popularize Radio," I will say I think enough of it to begin asking questions. Is it not true that the big fault is in the fact that there is nothing to prevent individuals from buying cheap crystal sets outright, or, for that matter, constructing their own, and avoid paying rents? The telephone companies get their compensation for service by owning the lines. Who owns the air? Even if the local broadcaster sold every outfit used the profit would not be sufficient to buy and maintain a broadcasting outfit. Undoubtedly the idea is novel and has merit but the financial scheme looks like a joker. If it was not for the financial draw-back the plan would have been in operation here months ago and we would have written to Mr. H. Gernsback about it, instead of him writing us about it.

"The only solution I see would be to appeal to the local Chamber of Commerce or the like. So far I have not been able to find any institution around here willing to support a local short range broadcasting station."

Send $1.00 to Radio Age, 64 W. Randolph Street, Chicago, and receive this middle-west radio periodical for six months. Regular subscription price is $2.50 a year.

Questions and Answers

Free Special Service Department, Conducted by Frank D. Pearne

For prompt replies by mail, readers should enclose self-addressed and stamped envelope with their inquiries.

C. P. J., St. Louis, Mo.

Question: I built a Reinartz receiving set, as per your diagram in last months Radio Age. I am not having any results with it on long distance stations. If I get any long distance stations, there is a howl or whistle in the coil or tube all the time. If I put my hand near the dials, or tuning switches, it makes the noise worse. Sometimes I can put my hand in a certain place and if I hold it there I can tune the stations in, but rs soon as I move my hand, it will start to whistle. I have a two-strand aerial about 30 feet long. I have got the 23 plate condenser on the ground side, with the rotating part hooked to the ground and I have got the 43 plate on the aerial side, with the rotating part hooked to the aerial. I have got a .0005 grid condenser hooked between the grid and the coil and I am using a U. V. 200 detector tube. I am not using any amplification at all. Could this be my trouble? If I use a crystal coil in series with the aerial to the tube set, I can get pretty good results. If I do not use this coil, there is a howling noise all the time. I get KSD loud enough to hear all over the room from the phones, without the crystal coil. The crystal coil just works good on long distance stations.

Answer: I think that you can stop some of the howling by lining the back of your panel with tin foil and connecting it to the ground. You can cut away the tinfoil at any place where the instruments on the panel might touch it. Nothing should come in contact with it but the ground wire. If you put your hand near the coil, the whistling would probably cease, but it should not be necessary to use the hand at all. You will find that in getting long distance stations, the rheostat of the detector ube is the most sensitive of all the adjustments. This really should be of the vernier type. I have found it impossible to get distance with these sets without turning down the filament rheostat to a much lower point than that used for local stations. Your statement about the addition of the crystal coil is interesting. This of course adds inductance to your set and would tend to show that there are not enough turns on it. The fact that you don't need the coil when getting local stations means nothing, as at close range the tuning is so broad that you could get them even though there are not enough turns on your coil, but with distance stations it is different. Here you need sharp tuning and if the wave length of the coil was too low on account of not enough wire you would have trouble. You do not need your amplifier to bring in distance, as it will only intensify those sounds which are brought in on the detector. If you are sure your winding is correct according to the drawing, I would advise you to wind another coil, using a few more turns in the aerial and grid coils.

F. L. G., Chicago, Ill.

Question: I have been doing considerable experimenting using the Reinartz circuit described in a late issue of the Radio Age, and have obtained some wonderful results on short wave work. What I would like to know is, can I load this circuit sufficiently to get the large commercial stations, say from 5,000 meters up. If so, where is the proper place to insert the proper inductances? I am planning on using honey-comb coils. Will I need an extra coil in the feed back circuit, that is, in the 60 turn coil?

Answer: This tuner can be loaded very nicely. It is best done by adding a switch point at the beginning of the aerial coil. This is just adding one more contact which is not connected to the coil. Another extra switch contact is added on the extreme end of the grid switch, but not connected to the coil. A honey-comb coil is then connected across these two contact points, with a tap taken off about three quarters of the way from the end on the aerial switch. This tap is then connected to the ground. No additional connection is used on the plate, or tickler coil. With the two switches on these new points long wave reception can be obtained. The length of the waves so received will depend only upon the number of turns in this exterior coil. Several of these may be made, making it possible to tune in on several different wave lengths.

F. G., Pittsburgh, Pa.

Question: Can a spider web Reinartz tuner, as given in Radio Age in September, be used with a Galena Detector and W D 11 tubes (2 of them) as amplifiers with loud speaker attached? If so, what distance would this tune up to? Give hook-up, stating what batteries, kind of transformers, etc., I need. If Reinartz tuner won't work, with crystal detector and W D 11 tubes, what tuner would you recommend? I have at present a double slide tuner," with fixed condenser and Galena detector. What would the probable life of the batteries be for WD 11 tubes? If Reinartz tuner works, with WD11 tubes, would it improve it to have a WD11 tube before the Galena detector, as well as the 2 after? I am told that the WD11 tubes give a smoother tone than the regular vacuum tubes. Is that so?

Answer: The Reinartz tuner can be used for this purpose, but I would advise the use of the long distance crystal set described elsewhere in this issue. The volume will not be so great as would be obtained with the larger tubes but it could be used with a loud speaker. The wave length could be anything you want, depending upon the number of turns on the vario-coupler, and the distance might be anything up to 100 miles, or more. By putting one of these tubes ahead of the crystal, greater distance could be brought in. The WD11 tubes do give a very smooth reception and many users say that they are much better than the larger tubes for detectors, but as amplifiers, they work well, but do not have the volume of the larger tubes. One dry cell will run a tube of this kind for about three months if used for one hour every day. If you use three tubes, three cells connected in parallel would run them for the same length of time.

W. S. J., Quincy, Ill.

Question: I am much interested in the Armstrong super-regenerative circuit built by Mr. Paul B. Coats, as described in the September number of Radio Age. I have had but little experience in building sets and fear the chances for success would be very small, unless I had the assistance showing the arrangement of instruments on panel, etc. Could you give me a sketch of same? The circuit looks very simple on paper, but I learn from wise heads that such is not the case with anything super-regenerative. Would it be feasible to build the circuit with unit panels, such as Sears Roebuck & Co., adding the extra condensers, etc.?

Answer: I am very sorry that I have no panel layout for the Armstrong super-regenerative set which you mention. There are some two or three dozen of these circuits out, and the panels for each one would have to be different. I am sure, however, that if you would write to Mr. Coats, he would oblige you with a sketch of the panel which he is using. His address is 336 W. 47th St., Chicago, Ill. Very few amateurs have been able to make this circuit function, or very few experts for that matter, and those who have done so, say that there are many other circuits which are better for receiving distance than the Armstrong super. The panel arrangement which you mention, would be a very good idea, as it would enable you to try out many different circuits by changing the units about.

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Interference Causes Lawsuit

THE question as to whether or not one may use the air and space as provided by the Maker of the universe in a free and untrammeled way is to be decided at an early session of the Livingston county (Ill.) circuit court.

The question as to whether any one person has more liberty in the use of the ether of space has been brought in the case of Edward McWilliams, a resident of Dwight, against Wiley Bergman, also a resident of Dwight, and both ardent amateur radio fans. The case is the first one heard of in the state of Illinois and possibly the first of the amateur sort in the United States.

In his bill as filed Mr. McWilliams sets forth the fact that he is interested in radio and has had his residence property in Dwight equipped with wires and apparatus necessary to receive the messages and information sent out by the various radio sending stations of considerable size and in any considerable part of the United States, which apparatus cost him a considerable sum, to-wit $500.

He also states that in Dwight, which is a town of about 2,000 population, there are from fifteen to twenty receiving outfits similar to his own. He states further that he has made a considerable study of radio and receives much emjoyment and pleasure from receiving of market reports, items of current news, concerts and programs which are sent out by the radio sending stations.

The bill then states that one Wiley Bergman, who is also a resident of Dwight, has established a radio sending apparatus and station of great power; that he is not engaged in any business which calls for the sending of messages and communications by radio and does not send messages to any profit to himself.

The bill states further that whenever Bergman's apparatus is in operation in the sending of messages that it interferes with the receiving apparatus of Mr. McWilliams and with the radio apparatus of other residents of Dwight and that their outfits are wholly useless and ineffective regardless of the skill with which they are operated and that Bergman will not and does not confine himself to any regular hours or times for operating his sending apparatus, but starts and operates it at times and hours when he well knows that the other owners of radio outfits in Dwight are receiving concerts, programs, market reports from sending stations in larger cities and that Bergman well knows that the sending stations in Chicago, Davenport, St. Louis, Atlanta and other cities have programs announced in advance to be broadcasted each day and well knows that persons in Dwight are enjoying them and that he does not regard the right of the plaintiff and other persons in receiving these programs but frequently interferes with them and renders them wholly useless.

The bill sets forth that on November 7, election day, that while the plaintiff was receiving the election returns that his apparatus was rendered useless because of the fact that Bergman by reason of his disregard of the rights of the plaintiff so used his sending apparatus that the receiving of the election returns was interfered with and stopped for more than six times in the one day.

The bill states that because of the great development of the radio that a sending station should be so operated and controlled that it will not necessarily make useless the apparatus owned by the various receivers. The bill also states that it is really possible for Bergman to use his sending apparatus at times each day when it will not seriously annoy and inconvenience the plaintiff and the other residents of Dwight in the use and enjoyment by them of their receiving apparatus.

Mr. McWilliams, in his bill, asks that Bergman may be enjoined and restrained from using his radio sending apparatus as to interfere with the rights of the plaintiff to the reasonable use, enjoyment and benefit of his radio receiving apparatus, and so using his sending outfit as to render useless and of small value the receiving outfit, and from so using his sending outfit as to unnecessarily and unreasonably depreciate the value of the plaintiff's property and from using his radio sending outfit at such hours of the day as he well knows are daily used, by the sending stations in the larger cities for the broadcasting of their programs and which he well knows are being received by the plaintiff and other citizens of Dwight. Mr. McWilliams also asks that the right of himself and the rights of the defendant may be fully established.

The case is a unique one and involves some questions of law entirely new. It undoubtedly will be closely watched, both by radio fans throughout the state and country when it comes to trial, but also by attorneys who have not yet experienced such a problem.—From the Pontiac (Ill.) Leader.

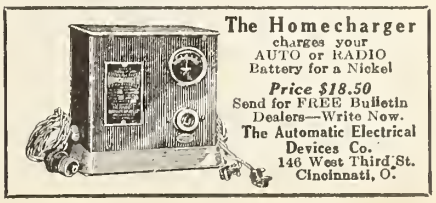
Symphony Concerts

Sunday afternoon popular concerts by the City Symphony Orchestra, are being broadcast by the Westinghuse-Radio Corporation station, WJZ, at Newark. These concerts are held at the Manhattan Opera House, 34th Street & 8th Avenue, New York City, and are conveyed to WJZ by a special Western Union wire. The programs consist of gems from the lighter classics together with shorter symphonic poems. Young soloists of real talent and distinction are heard at each performance.

The City Symphony Orchestra, which is maintained by the Musical Society of the City of New York, consists of 83 players carefully selected for their musical talent and symphonic experience. The conductor, Mr. Dirk Foch, a native of Holland and a composer of distinction, has had a successful career as a conductor of symphony concerts and opera in Amsterdam, The Hague, Stockholm, Gothenburg, and other European cities. He conducted several stadium concerts in 1919, a special Carnegie Hall concert in 1920, and was guest conductor of the St. Louis Symphony Orchestra for two concerts in 1921.

The object of the Musical Society of New York is to bring orchestral music of the highest standard within the reach of the general public. It therefore welcomed with enthusiasm the proposal to broadcast its concerts to the hundreds of thousands composing the radio audience and is preparing to make these concerts the finest musical event ever handled by radio. Before each performance a member of the Society discusses the compositions to be heard, and explains their musical significance.

The series of concerts was started late in November.



Corrected List of U. S. Stations Alphabetically by Call Signals

KDKA, E. Pittsburgh, Pa.; Class B station, up to 485 meters; Westinghouse Elec. & Mfg. Co.
KDN, San Francisco, Calif.; Leo J. Meyberg Co.
KDOW, Steamship America, New York.
KDPM, Cleveland, Ohio; Westinghouse Elec. & Mfg. Co.
KDPT, San Diego, Calif.; Southern Elec. Co.
KDYL, Salt Laks City, Utah; news music, entertainment, Telegram Publishing Co.
KDYM, San Diego, Calif.; Savoy Theatre.
KDYD, San Diego, Calif.; Carlson & Simpson.
KDYQ, Portland, Ore.; Oregon Inst. Technology.
KDYR, Pasadena, Calif.; Pasadena Star News Pub. Co.
KDYS, Great Falls, Mont.; Class B, 485 meters, Great Falls Tribune.
KDYV, Salt Lake City, Utah; Cope & Cornwell Co.
KDYW, Phoenix, Arizona; Smith Hughes & Co.
KDYA, Honolulu, Hawaii; Honolulu Star Bulletin Co.
KDZA, Tucson, Ariz.; Arizona Daily Star.
KDZB, Bakersfield, Calif.; Frank E. Seiffert.
KDZE, Seattle, Wash.; Rhodes Co.
KDZF, Los Angeles, Calif.; Automobile Club of Southern California.
KDZG, San Francisco, Calif.; Cyrus Pierce & Co.
KDZH, Fresno, Calif.; Fresno Evening Herald, Class B, 845.
KDZI, Wenatchee, Wash.; Electric Supply Co.
KDZK, Reno, Nev.; Nevada Machinery & Elec. Co.
KDZL, Ogden, Utah; Rocky Mountain Rad. Corp.
KDZM, Centralia, Wash.; E. A. Hollingworth.
KDZP, Los Angeles, Calif.; Newbery Electric Co.
KDZQ, Denver, Colo.; Motor Generator Co.
KDZW, San Francisco, Calif.; Clauds W. Gerdes.
KDZX, San Francisco, Calif.; Glad Tidings Tabernacle.
KDZZ, Everett, Washington; Kinney Bros. & Sipprell.
KFAC, Glendale, Calif.; Class B, 845, Glendale Daily Press.
KFAD, Phoenix, Ariz.; Class B, 485, McArthur Bros. Mercantile Co.
KFAE, Pullman, Wash.; State College of Washington.
KFAF, Denver, Colo.; George S. Walker, Western Radio Corp.
KFAJ, Boulder, Colo.; University of Colorado.
KFAN, Moscow, Idaho; Electric Shop.
KFAP, Butte, Mont.; Standard Pub. Co.
KFAQ, San Jose, Calif.; City of San Jose.
KFAR, Hollywood, Calif.; Studio Lighting Service Co.
KFAS, Reno, Nev.; Reno Motor Supply Co.
KFAT, Eugene, Oregon; Pacific Radio Co.
KFAU, Boise, Idaho; Class B, 485, Boise High School.
KFAV, Venice, Calif.; Abbott Kinney Co.
KFAW, Santa Anna, Calif.; Class B, 485, Radio Den.
KFAY, Central Point, Ore.; W. J. Virgin Milling Co.
KFBA, Lewiston, Idaho; Ramey & Bryant Radio Co.
KFBB, Havre, Mont.; F. A. Buttrey & Co.
KFBC, San Diego, Calif.; W. K. Azbill.
KFBD, Hanford, Calif.; California Radio Lab.
KFBE, San Louis Obispo, Calif.; R. H. Horn.
KFBG, Tacoma, Wash.; First Presbyterian Church.
KFBH, Marshfield, Ore.; Thomas Musical Co.
KFBJ, Boise, Idaho; Boise Radio Supply Co.
KFBK, Sacramento, Calif.; Kimball-Upson Co.
KFBL, Everett, Wash.; Leese Bros.
KFBM, Astoria, Ore.; Cook & Foster.
KFBQ, Prescott, Ariz.; Savage Elec. Co.
KFBU, Laramie, Wyo.; N. S. Thomas.
KFBV, Colorado Springs, Colo.; Clarence O. Ford.
KFC, Seattle, Wash.; Northern Radio & Elec. Co.
KFCB, Phoenix, Ariz.; Nielson Radio Supply Co.
KFCC, Wallace, Ida.; Auto Supply Co.
KFCD, Salem, Ore.; F. S. Barton.
KFCF, Walla Walla, Wash.; Frank A. Moore.
KFCH, Billinge, Mont.; Elec. Service Station.
KFCK, Colorado Springs, Colo.; Colorado Springe Radio Co.
KFDA, Baker, Ore.; Adler's Music Store.
KFED, Billings Polytechnic Institute, Polytechnic, Mont.
KFDB, San Francisco, Calif.; Mercantile Trust Co., also 400.
KFDD, Boise, Idaho; St. Michael's Cathedral.
KFDS, San Francisco, Calif.; John D. McKee.
KFEB, Taft, Calif.; City of Taft.
KFCQ, Casper, Wyo.; Motor Service Station.
KFDL, Denver, Colo.; Knight Campbell Music Co.
KFDJ, Corvallis, Ore.; Oregon Agri. College.
KFDC, Spokane, Wash.; Radio Supply Co.
KFDF, Casper, Wyo.; Wyoming Radio Corp.
KFEC, Portland, Ore.; Meier & Frank Co.
KFFA, San Diego, Calif.; Dr. R. C. Shelton.
KFCL, Loe Angeles, Calif.; Los Angeles Union Stock Yards.
KFFE, Pendleton, Ore.; Eaetern Orsgon Radio Co.
KFEJ, Tacoma, Wash.; Guy Greason.
KFGG, Astoria, Ore.; Aetoria Budget.
KFGH, Stanford Univ., Calif.
KFI, Los Angeles, Calif.; Earl C. Anthony, Inc.
KFU, Gridley, Calif.; Ths Precision Shop.
KFV, Yakima, Wash.; Foster-Bradbury Radio Store.
KFZ, Spokane, Wash.; Doerr-Mitchell Elec. Co.
KGB, Tacoma, Wash.; Tacoma Daily Ledger; Wm. A. Mullen's Elec. Shop.
KGF, Pomona, Calif.; Pomona Fixture & Wiring Co.
KGG, Portland, Ore.; Hallock & Watson Radio Service.
KGN, Portland, Ore.; Northwestern Radio Mfg. Co.
KGO, Altadena, Calif.; Altadena Radio Laboratory.
KGU, Honolulu, Hawaii, Waikiki Beach, Marion A. Mulroney; Honoluiu Advertiser.
KGW, Portland, Ore.; Oregonian Pub. Co., also 400.
KGY, Lacey, Wash.; St. Martin's College, (Rev. S. Ruth).
KHD, Colorado Springe, Colo.; Class B, 485, C. F. Aldrich; Marble & Granite Co.
KHJ, Los Angeles, Calif.; C. R. Klieruff & Co.; Times Mirror Co., Class B, 400-485.
KHQ, Seattle, Wash.; Louie Wasmer.
KJC, Los Angeles, Calif.; Standard Radio Co.
KJJ, Sunnyside, Calif.; The Radio Shop.
KJQ, Stockton, Calif.; C. O. Gould.
KJS, Los Angeles, Calif.; Bible Inst. of Los Angeles.
KLB, Pasadena, Calif.; J. J. Dunn & Co.
KLM, Del Monte, Calif.; Noggle Elec. Works.
KLP, Los Altos, Calif.; Colin B. Kennedy Co.
KFDH, Tucson, Ariz.; Univ. of Arizona.
KLS, Oakland, Calif.; Warner Bros.
KLX, Oakland, Calif.; Tribune Pub. Co.
KLZ, Denver, Colo.; Class B, 485, Reynolds Radio Co.
KMAZ, Macon, Ga., Mercer University.
KMC, Reedley, Calif.; Lindsay-Wetherill Co.
KMJ, Fresno, Calif.; 485, San Joaquin Light & Power Co.
KMO, Tacoma, Wash., Love Electric Co.; Tacoma Times.
KNI, Eureka, Calif.; T. W. Smith.
KNJ, Roswell, New Mexico; 485, Roswell Public Utilities Co.
KNN, Los Angeles, Calif.; Bullocke.
KNT, Aberdeen, Wash.; North Coast Producte Co.
KNV, Loe Angeiee, Calif.; Radio Supply Co.
KNX, Los Angeles, Calif.; Elec. Lighting Supply Co.
KOA, Denver, Colo.; Y. M. C. A.
KOB, State College, New Mex.; New Mexico Collego of Agri. & Mechanic Arts.
KOE, Spokane, Wash.; Spokane Chronicle.
KOG, Los Angeles, Calif.; Western Radio Electric Co.
KON, Los Angelee, Calif.; Holzwasser, Inc.
KDP, Detroit, Mich., Detroit Polics Dept.
KOQ, Modesto, Calif., Modeeto Evening News.
KPD, San Francisco, Calif., Hale Bros.
KQI, Berkeley, Calif., Univ. of California.
KQP, Hood River, Ore., Blue Diamond Elec. Co.; Hood River News.
KQV, Pitteburgh, Pa., Doubleday-Hill Elec. Co.
KQW, San Jose, Calif., Chas. D. Herrold.
KQY, Portland, Ore., Stubbs Elec. Co.
KRE, Berkeley, Calif., Maxwell Electric Co.
KSD, St. Louis, Mo., St. Louie Post-Diepatch.
DSC, San Joes, Calif., O. A. Hals & Co.
KSL, San Francisco, Calif., The Emporium.
KSS, Long Beach, Calif., Preet & Dean Radio Research Lab.
KSU, Wenatchee, Wash., 360 and 485.
KTW, Seattle, Wash., First Presbyterian Church.
KUO, San Francisco, Calif., Examiner Printing Co., San Fran. Examiner.
KUS, Los Angeles, Calif., City Dye Worke & Laundry Co.
KUY, Del Monte Calif., Coast Radio Co.
KVQ, Sacramento, Calif., James McClatchy; J. C. Hobrecht.
KWG, Stockton, Calif., Portable Wireleee Telephons Co.
KWH, Los Angeles, Calif., 485 also Los Angeles Examiner.
KXD, Modesto, Calif., Herald Publishing Co.
KXS, Los Angeles, Calif., Braun Corp.
KYF, San Diego, Calif., Thearls Music Co.
KYI, Bakersfield, Calif., Alfred Harrell.
KYJ, Los Angeles, Calif., Leo J. Meyberg Co.
KYQ, Honolulu, T. H., The Electric Shop.
KYW, Chicago, Ill., Westinghouse Elec. & Mfg. Co.
KYY, San Francisco, Calif., The Radio Telephone Shop.
KZC, Seattle, Wash., Public Market & Dept. Store Co.
KZM, Oakland, Calif., Western Radio Inst.; Preston D. Allen.
KZN, Salt Lake City, Utah, The Deseret News.
KZV, Wenatchee, Wash., Wenatchee Battery & Motor Co.
KZY, San Francisco, Calif., Atlantic-Pacific Radio Supplies Co.
NOF, Anacostia, D. C., 412 only, U. S. Navy Dept.
PWX, Havana, Cuba, Cuban Telephone Co.
WAI, Dayton, Ohio, McCook Field, U. S. Army.
WAAB, New Orleans, La., Valdemar Jensen.
WAAC, New Orleans, La., Tulane Univ.
WAAD, Cincinnati, Ohio, Ohio Mechanics Inst.
WAAF, Chicago, Ill., Chicago Daily Drovers Journal.
WAAE, St. Louis, Mo., St. Louis Chamber of Commerce.
WAAG, Shreveport, La., Bordeaux Co.; Elliott Electric Co.
WAAH, St. Paul, Minn.; Commonwealth Electric Co.
WAAJ, Boston, Mass., Eastern Radio Inst.
WAAK, Milwaukee, Wis., Gimbel Broe.
WAAM, Newark, N. J., I. R. Nelson Co.
WAAL, Minneapolis, Minn., Minnesota Tribune Co. & Anderson-Beamish Co.
WAAN, Columbia, Mo., Univ. of Missouri.
WAAD, Charleston, W. Va., Radio Service.
WAAP, Wichita, Kans., United Elec. Co.; Otto W. Taylor.
WAAQ, Greenwich, Conn., New England Motor Sales Co.
WAAR, Huntington, W. Va., Groves-Thornton Hdwe. Co.
WAAS, Decatur, Ga., Georgia Radio Co.
WAAT, Jersey City, N. J., Athens Radio Co.
WAAV, Athens, Ohio, Athens Radio Co.
WAAW, Omaha, Neb., Omaha Grain Exchange.
WAAX, Crafton, Pa., Radio Service Corp.
WAAY, Youngstown, Ohio, Yohrling Rayner Music Co.
WAAZ, Emporia, Kansas Hollister-Miller Motor Co.
WAH, El Dorado, Kans., Midland Refining Co.
WAJT, Marshall, Mo., Kelly-Vawter Jewelry Co.
WAJU, Yankton, S. D., Yankton College.
WBAA, W. Lafayette, Ind., Purdus University.
WBAB, Syracuse, N. Y., Syracuse Radio Tel. Co.; Andrew J. Potter.
WBAD, Minneapolis, Minn., Sterling Elec. Co. & Journal Printing Co.
WBAE, Peoria, Ill., Bradley Polytechnic Inst.
WBAJ, Moorestown, N. J., Fred M. Middleton.
WBAG, Bridgeport, Pa., Diamond State Fibre Co.
WBAH, Minneapolis, Minn., The Dayton Co.
WBAJ, Toledo, Ohio, Marshall-Gerken Co.
WBAM, New Orleans, La., I. B. Rennyson.
WBAN, Paterson, N. J., Wireless Phone Corp.
WBAD, Decatur, Ill., James Millikin Univ.
WBAQ, South Bend, Ind., Myron L. Harmon.
WBAP, Fort Worth, Texas, 400 and 485; also Ft. Worth Star Telegram; Worthan-Carter Publishing Co.
WBAU, Hamilton, Ohio, Republican Publishing Co.
WBAV, Columbus, Ohio, 485, also Erner & Hopkins Co.
WBAW, Marietta, Ohio, Marietta College.
WBAX, Wilkes-Barre, Pa., John H. Stenger, Jr.
WBAY, New York, N. Y., American Telephone & Telegraph Co.
WBL, Anthony, Kans., T. & H. Radio Co.
WBS, Newark, N. J., D. W. May, Inc.
WBT, Charlotte, N. C., 485 also Southern Radio Corp.
WBU, Chicago, Ill., City of Chicago.
WBZ, Springfield, Maes., Westinghouse Elec. & Mfg. Co.
WCAB, Newburgh, N. Y., Newburgh Daily News; Newburgh News Printing & Pub. Co.
WCAC, Fort Smith, Ark., John Fink Jewelry Co.
WCAD, Canton, N. Y., St. Lawrence University.
WCAE, Pittsburgh, Pa., Kaufman & Baer Co.
WCAG, New Orleans, La., Daily States Pub. Co.
WCAH, Columbus, Ohio, Entrekin Elec. Co.
WCAI, San Antonio, Texas, Southern Equipment Co.
WCAJ, Univ. Place, Neb., Nebraska Wesleyan University.
WCAK, Houston, Texae, Alfred P. Daniel.
WCAL, Northfield, Minn., St. Olaf College.
WCAM, Villanova, Pa., Villanova Collegs.
WCAO, Baltimore, Md., Sandere & Stayman Co.
WCAP, Kalamazoo, Mich., Kalamazoo College.
WCAQ, Defiance, Ohio, Tri-State Radio Mfg. Co.
WCAR, San Antonio, Texas, Alamo Radio Elec. Co.
WCAS, Minneapolis, Minn., Wm. H. Dunwoody Industrial Inst.
WCAT, Rapid City, S. Dak., 485 also South Dakota School of Mines.
WCAU, Philadelphia, Pa., Philadelphia Radiophone Co.
WCAV, Little Rock, Ark., J. C. Dice Elec. Co.
WCAW, Omaha, Nebr., Woodmen of the World.
WCAX, Burlington, Vermont, University of Vermont.
WCAY, Milwaukes, Wis., Kesselman O'Driscoll Co.
WCAZ, Quincy, Ill., Robt. E. Compton & Quincy Whig-General.
WCE, Minneapolis, Minn., Findley Elec. Co.
WCJ, New Haven, Conn., A. C. Gilbert Co.
WCK, St. Louis, Mo., Stix Baer & Fuller.
WCM, Austin, Texas, Univ. of Texas.
WCN, Worcester, Maee., 485 also Clark University.
WCX, Detroit, Mich., Detroit Free Press.
WDAC, Springfield, Ill., Ill Watch Co.
WDAE, Tampa, Fla., 485 also Tampa Daily News.
WDAF, Kansas City, Mo., 400 and 485, also Kansas City Star.
WDAG, Amarillo, Texae, K. Laurence Martin.
WDAH, El Paso, Texae, Mine & Smelter Supply Co.
WDAI, Syracuse, N. Y., 485 also Hughes Electrical Corp.
WDAJ, College Park, Ga., Atlanta & West Point R. R. Co.
WDAK, Hartford, Conn., Hartford Coursnt.
WDAL, Jacksonville, Fla., 485 also, Florida Times Union.
WDAN, Shreveport, La., Centenary College and Glenwood Radio Corp.
WDAO, Dallae, Texas, Automotive Elec. Co.
WDAP, Chicago, Ill., 485 also, Midweet Radio Central (Inc.).
WDAG, Brownevills, Pa., Hartman-Riker Elec. & Mach.Co.
WDAR, Philadelphia, Pa., Lit Bros.
WDAS, Worcester, Mase., Samuel A. Waite.
WDAU, New Bedford, Mass., Slocum & Kilburn.
WDAV, Muskogee, Okla., Daily Phoenix.
WDAX, Centerville, Iowa, Firet Nat'l Bank.
WDAY, Fargo, N. D., Kenneth M. Hance.
WDM, Washington, D. C., Church of the Covenant.
WDT, New York, N. Y., Ship Owners Radio Service.
WDV, Omaha, Nebr., John O. Yeiser, Jr.
WDY, Roeelle Park, N. J., Radio Corp. of America.
WDZ, Tuscola, Ill., James L. Bush.
WEAA, Flint, Mich., Fallain & Lathrop.

Corrected List of U. S. Stations Alphabetically by Call Signals

WEAB, Fort Dodge, Iowa, Standard Radio Equip. Co.
WEAC, Terre Haute, Ind., Baines Elec. Service Co.
WEAO, Atwood, Kans., Northwest Kansas Radio Supply Co.
WEAE, Blackaburg, Va., Virginia Polytechnic Inst.
WEAF, New York City, N. Y., Western Electric Co.
WEAG, Edgewood, R. I., Nichols-Hineline-Baasett Lab.
WEAH, Wichita, Kans., Wichita Board of Trade and Lander Radio Co.
WEAI, Ithaca, N. Y., Cornell University.
WEAJ, Vermilion, S. Dak., University of South Dakota.
WEAK, St. Joseph, Mo., Julius B. Abercrombie.
WEAM, North Plainfield, N. J., Burough of N. Plainfield.
WEAN, Providence, R. I., The Shepard Co.
WEAO, Columbus, Ohio, Ohio State University.
WEAP, Mobile, Ala., 485 also Mobile Radio Co.
WEAQ, Berlin, N. H., Y. M. C. A.
WEAR, Baltimore, Md., Balt. American & News Pub. Co.
WEAS, Washington, D. C., The Hecht Co.
WEAT, Tampa, Fla., John J. Fogarty.
WEAU, Sioux City, Iowa, Davidson Bros. Co.
WEAV, Rushville, Nebr., Sheridan Elec. Service Co.
WEAW, Anderson, Ind., Arrow Radio Lab.
WEAX, Little Rock, Ark., T. J. M. Daly.
WEAY, Houston, Texas, Will Horwitz, Jr.
WEAZ, Waterloo, Iowa, Donald Redmond.
WEB, St. Louis, Mo., The Benwood Co., Inc.
WEH, Tulaa, Okla., Midland Refining Co.
WEV, Houston, Texa, 485 also Hurlburt-Still Elec. Co.
WEW, St. Louis, Mo., 485 also St. Louis Univ.
WEY, Wichita, Kansas, 485 also Cosradio Co.
WFAA, Dallas, Texas, 400 and 485 also A. H. Belo & Co.
WEAB, Syracuse, N. Y., C. F. Woese.
WFAC, Superior, Wis., Superior Radio Co.
WFAO, Salina, Kans., Watson Weldon Motor Supply Co.
WFAF, Poughkeepsie, N. Y., H. C. Spratley Radio Co.
WFAG, Waterford, N. Y., Radio Engineering Lab.
WFAH, Port Arthur, Texaa, Elec. Supply Co.
WFAJ, Asheville, N. C., Hi-Grade Wireless Instrument Co.
WFAK, Brentwood, Mo., Domestic Electric Co.
WFAM, St. Cloud, Minn., 485 also Granite City Elec. Co. and Times Pub. Co.
WFAN, Hutchinson, Minn., 485 also Hutchinson Electric Service Co.
WFAQ, Cameron, Mo., Cameron Radio Co. and Mo. Wesleyan College.
WFAR, Sanford, Me., Hall & Stubbs.
WFAS, Fort Wayne, Ind., United Radio Corp.
WFAT, Sioux Falls, S. Dak. 485; also Argus-Leader.
WFAU, Boston, Mass., Edwin C. Lewis.
WFAV, Lincoln, Nebr., 485 also Univ. of Nebr. Dept. of Elec. Engineering.
WFAW, Miami, Fla., Daily Metropolis.
WFAY, Independence, Kans., Daniels Radio Supply Co.
WFAZ, Charleston, S. Carolina, S. C. Radio Shop.
WFI, Philadelphia, Penn., 400 and 485, also Strawbridge & Clothier.
WFO, Dayton, Ohio, Rike-Kumler Co.
WGAB, Houston, Texas, QRV Radio Co.
WGAC, Brooklyn, N. Y., Orpheum Radio Stores Co.
WGAO, Ensenada, Porto Rico, Spanish-American School of Radio-telegraphy.
WGAH, New Haven, Conn., New Haven Elec. Co.
WGAJ, Shenandoah, Iowa, W. H. Gass.
WGAK, Macon, Ga., Macon Elec. Co.
WGAL, Lancaster, Pa., Lancaster Elec. Supply & Construction Co.
WGAM, Orangeburg, S. C., Orangeburg Radio Equip. Co.
WGAN, Pensacola, Fla., Cecil E. Lloyd.
WGAQ, Shreveport, La., Glenwood Radio Corp.
WGAR, Fort Smith, Ark., Southwest American.
WGAS, Chicago, Ill., Ray-di-co Organization, Inc.
WGAT, Lincoln, Nebr., Am. Legion, Dept. of Nebr.
WGAU, Wooster, Ohio, Marcus G. Limb.
WGAV, Savannah, Ga., B-H Radio Co.
WGAW, Altoona, Pa., Ernest C. Albright.
WGAX, Washington Court House, Ohio, Ohio Radio Elec. Co.
WGAY, Madison, Wis., North Western Radio Co.
WGAZ, South Bend, Ind., South Bend Tribune.
WGF, Des Moines, Iowa, 485, also Register and Tribune.
WGI, Medford Hillside, Mass., 485, also Am. Radio & Research Corp.
WGL, Philadelphia, Pa., Thos. F. J. Howlett.
WGM, Atlanta, Ga., 400 only, Atlanta Constitution.
WGR, Buffalo, N. Y., 485 also Federal Tel. & Teleg. Co.
WGV, New Orleans, La., Interstate Elec. Co. 485 also.
WGY, Schenectady, N. Y., 400 and 485 also General Elec. Co.
WHA, Madison, Wis., 485 also Univ. of Wis.
WHAA, Iowa City, Iowa, State Univ. of Iowa.
WHAB, Galveston, Texas, 300, 485, 600 also Clark W. Thompson (Fellman's Dry Goods Co.)
WHAC, Waterloo, Iowa, Cole Bros. Elec. Co.
WHAO, Milwaukee, Wis., 485 also; Marquette Univ.
WHAE, Sioux City, Iowa, Automotive Elec. Service Co.
WHAF, Pittsburgh, Pa., Radio Elec. Co.
WHAG, Cincinnati, Ohio, Univ. of Cincinnati.
WHAH, Joplin, Mo., John T. Griffin.
WHAI, Davenport, Iowa, Radio Equip. & Mfg. Co.
WHAJ, Bluefield, W. Va., Bluefield Daily Telegraph and E. K. Klitta.
WHAK, Clarksburg, W. Va., Roberts Hdwe. Co.
WHAL, Lansing, Mich., Lansing Capitol News.
WHAM, Rochester, N. Y., Univ. of Rochester.
WHAO, Savannah, Ga., Frederick A. Hill; every evening 8 to 9; Saturday nights, 12:30 1:30 a. m.
WHAP, Decatur, Ill., Dewey L. Otta.
WHAQ, Washington, D. C., Semmes Motor Co.
WHAR, Atlantic City, N. J., Paramount Radio & Elec. Co.
WHAS, Louisville, Ky., Courier Journal and Louisville Times Co.
WHAV, Wilmington, Del., Wilmington Elec. Spec. Co.
WHAW, Tampa, Fla., Pierce Elec. Co.
WHAY, Huntington, Ind., Huntington Press.
WHAZ, Troy, N. Y., 400 only, Rensselaer Polytechnic Inst.
WHB, Kansas City, Mo., 400 and 485 also Sweeney Auto & Tractor School.
WHO, Morgantown, W. Va., W. Va. University.
WHK, Cleveland, Ohio, Warren R. Cox.
WHN, Ridgewood, N. Y., Times Printing & Pub. Co.
WHU, Toledo, Ohio, Wm. B. Duck Co.
WHW, East Lansing, Mich., 485 also Stuart W. Seeley.
WHX, Des Moines, Iowa, Iowa Radio Corp.
WIAA, Waupaca, Wis., Waupaca Civic & Commerce Ass'n.
WIAB, Rockford, Ill., Joslyn Automobile Co.
WIAC, Galveston, Texas, 485 also Galveston Tribune.
WIAD, Ocean City, N. J., Ocean City Yacht Club.
WIAE, Vinton, Iowa, Mrs. Robt. E. Zimmerman.
WIAF, New Orleans, La., Gustave A. De Cortin.
WIAH, Newton, Iowa, Continental Radio & Mfg. Co.
WIAI, Springfield, Mo., Heer Stores Co.
WIAJ, Neenah, Wis., Fox River Valley Radio Supply Co.
WIAK, Omaha, Neb., 485 also Daily Journal-Stockman.
WIAO, Milwaukee, Wis., School of Engineering.
WIAP, Springfield, Mass., Radio Development Corp.
WIAQ, Marion, Ind., Chronicle Pub. Co.
WIAR, Paducah, Ky., J. A. Rudy & Sons.
WIAS, Burlington, Iowa, Hawk-Eye Home Elec. Co.
WIAT, Tarkio, Mo., Leon T. Noel.
WIAU, Le Mars, Iowa, Am. Trust & Savings Bank.
WIAV, Binghamton, N. Y., N. Y. Radio Lab.
WIAW, Saginaw, Mich., Saginaw Radio & Elec. Co.
WIAX, Lincoln, Nebr., Capitol Radio Co.
WIAY, Washington, D. C., Woodword & Lothrop.
WIAZ, Miami, Fla., Elec. Supply Sales Co.
WIK, Mercersburg, Pa., K. & L. Elec. Shop.
WIL, Washington, D. C., Continental Elec. Supply Co.
WIP, Philadelphia, Pa., Gimbel Bros.
WIZ, Cincinnati, Ohio, 485 also Cino Radio Mfg. Co.
WJAB, Lincoln, Nebr., American Radio Co.
WJAC, Joplin, Mo., Redell Co.
WJAO, Waco, Texaa, 485 also Jackson'a Radio Engrng. Lab.
WJAE, San Antonio, Texas, Texas Radio Syndicate.
WJAF, Muncie, Ind., Muncie Press and Smith Elec. Co.
WJAG, Norfolk, Neb., 485 also Norfolk Daily News.
WJAH, Rockford, Ill., Central Park Amusement Co.
WJAJ, Dayton, Ohio, Y. M. C. A.
WJAK, Stockdale, Ohio, 485 also White Radio Lab.
WJAL, Portland, Me., Victor Radio Corp.
WJAM, Cedar Rapids, Iowa, Evening Gazette.
WJAN, Peoria, Ill., Peoria Star and Peoria Radio Sales Co.
WJAP, Duluth, Minn., Kelley-Duluth Co.
WJAQ, Topeka, Kans., Capper Publications.
WJAR, Providence, R. I., The Outlet Co., J. Samuels & Bros.
WJAS, Pittsburgh, Pa., Pittsburgh Radio Supply House.
WJAT, Marshall, Mo., Kelley-Vawter Jewelry Co.
WJAX, Cleveland, Ohio, 485 also Union Trust Co.
WJAZ, Chicago, Ill., Chicago Radio Lab.
WJD, Granville, Ohio, Dennison University.
WJH, Washington, D. C., White & Boyer Co.
WJK, Toledo, Ohio, Service Radio Equipment Co.
WJX, New York, N. Y., De Forest Radio Telephone & Teleg. Co.
WJZ, Newark, N. J., 485 also Westinghouse Elec. & Mfg. Co.
WKAA, Cedar Rapids, Iowa, 485 also H. F. Paar.
WKAC, Lincoln, Neb., Star Pub. Co.
WKAO, East Providence, R. I., Charles Looff.
WKAF, Wichita Falls, Texas, W. S. Radio Supply Co.
WKAG, Louisville, Ky., Edwin T. Bruce, M. D.
WKAH, West Palm Beach, Fla., Planet Radio Co.
WKAK, Okemah, Okla., Okfuskee County News.
WKAL, Orange, Texas, Gray & Gray.
WKAM, Hastings, Neb., Daily Tribune.
WKAN, Montgomery, Ala., Alabama Radio Mfg. Co.
WKAP, Cranston, R. I., Dutee W. Flint.
WKAQ, San Juan, Porto Rico, Radio Corp. of Porto Rico.
WKAR, East Lansing, Mich., Mich. Agrl. College.
WKAS, Springfield, Mo., L. E. Lines Music Co.
WKAV, Laconia, N. H., Laconia Radio Club.
WKAW, Beloit, Wisc., Turner Cycle Co.
WKAX, Bridgeport, Conn., Wm. A. MacFarlane.
WKAY, Gainesville, Ga., Brenau College.
WKAZ, Wilkes-Barre, Pa., Landau's Music Co.
WKC, Baltimore, Md., Jos. M. Zamoiski Co.
WKN, Memphis, Tenn., Riechman-Crosby Co.
WKY, Oklahoma City, Okla., 485 also Oklahoma Radio Shop.
WLZ, Fairfield, Ohio, U. S. Army.
WLAG, Raleigh, N. C., N. C. State College.
WLAO, Hastings, Nebr., Arvanette Radio Supply Co.
WLAF, Lincoln, Nebr., Johnson Radio Co.
WLAG, Minneapolis, Minn., Cutting & Walsh Radio Corp.
WLAH, Syracuse, N. Y., Samuel Woodworth.
WLAJ, Waco, Texas, 485 also Waco Elec. Supply Co.
WLAK, Bellows Falls, Vt., Vermont Farm Machine Co.
WLAL, Tulsa, Okla., Tulsa Radio Co.
WLAM, Springfield, Ohio, Morrow Radio Co.
WLAN, Houlton, Me., Putnam Hdwe. Co.
WLAO, Scranton, Pa., 485 also R. C. Ehrhardt and J. H. Jones.
WLAP, Louisville, Ky., W. V. Jordan.
WLAQ, Kalamazoo, Mich., A. E. Schilling.
WLAR, Marshalltown, Iowa, Meikel Music Co.
WLAS, Hutchinson, Kans., Hutchinson Grain Radio Co.
WLAT, Burlington, Iowa, Radio Specialty Co.
WLAV, Pensacola, Fla., Elec. Shop, Inc.
WLAW, New York, N. Y., New York Police Dept.
WLAX, Greencastle, Ind., Greencastle Community Broadcasting Station.
WLAY, Fairbanks, Alaska, Northern Commercial Co.
WLAZ, Warren, Ohio, Hutton & Jones Elec. Co.
WLB, Minneapolis, Minn., Univ. of Minn.
WLK, Indianapolis, Ind., 485 also Hamilton Mfg. Co.
WLW, Cincinnati, Ohio, 485 also Crosley Mfg. Co.
WMA, Anderson, Ind., Arrow Radio Lab.
WMAB, Oklahoma City, Okla., Radio Supply Co.
WMAC, Cazenovia, N. Y., C. B. Meredith.
WMAO, Rockport, Mo., Atchinson County Mail.
WMAE, Dartmouth, Mass., Round Hills Radio Corp.
WMAG, Liberal, Kans., Tucker Elec. Co.
WMAH, Lincoln, Nebr., General Supply Co.
WMAJ, Kansas City, Mo., 485 also Drovera Telegram.
WMAK, Lockport, N. Y., Norton Labs.
WMAL, Trenton, N. J., Trenton Hdwe. Co.
WMAM, Beaumont, Texaa, Beaumont Radio Equip. Co.
WMAN, Columbus, Ohio, First Baptist Church.
WMAP, Easton, Pa., Utility Battery Service.
WMAQ, Chicago, Ill., Chicago Daily News.
WMAR, Waterloo, Iowa, Waterloo Elec. Supply Co.
WMAT, Duluth, Minn., Paramount Radio Corp.
WMAV, Auburn, Ala., Polytechnic Inst.
WMAW, Wahpeton, N. D., Wahpeton Elec. Co.
WMAX, Ann Arbor, Mich., K. & K. Radio Supply Co.
WMAY, St. Louis, Mo., Kingshighway, Presby. Church.
WMAZ, Macon, Ga., Mercer University.
WMB, Auburn, Maine, Auburn Elec. Co.
WMC, Youngstown, Ohio, Columbia Radio Co.
WMH, Cincinnati, Ohio, 485 also Precision Equipment Co.
WMU, Washington, D. C., Doubleday-Hill Electric Co.
WNAB, Bowling Green, Ky., Park City Daily News.
WNAC, Boston, Mass., Shepard Stores.
WNAO, Norman, Okla., Okla. Radio Engineering Co.
WNAF, Enid, Okla., Enid Radio Dist. Co.
WNAG, Cresco, Iowa, Rothert Radio and Electric Shop.
WNAH, Manhattan, Kans., Manhattan Radio Supply Co.
WNAL, Omaha, Nebr., R. J. Rockwell.
WNAN, Syracuae, N. Y., Syracuse Radio Telephone Co.
WNAP, Springfield, Ohio, Wittenberg College.
WNAQ, Charleston, S. C., Charleston Radio Elec. Co.
WNAS, Austin, Texas, Radio Corp.
WNAT, Philadelphia, Pa., Lennig Bros. Co.
WNAV, Knoxville, Tenn., People's Tel. and Tel. Co.
WNAY, Baltimore, Md., Shipowners' Radio Service.
WNAX, Yankton, S. D., Dakota Radio Apparatus Co.
WNAW, Fortress Monroe, Va., Henry Kunzman.
WNJ, Albany, N. Y., Shotton Radio Mfg. Co., Inc.
WNO, Jersey City, N. J., Wirelesa Telephone Co. of Hudson Co., N. J.
WOAA, Ardmore, Okla., Dr. Walter Hardy.
WOAC, Lima, Ohio, Maua Radio Co.
WOAE, Fremont, Nebr., Medland College.
WOAF, Tyler, Texas, Tyler Commercial College.
WOAH, Charleston, S. C., Palmetto Radio Corp.
WOAI, San Antonio, Texas, 485 also, Southern Equip. Co.
WOAJ, Parsons, Kans., Erving's Electrical Co.
WOAK, Frankfort, Ky., Collins Hardware Co.
WOAL, Webster Groves, Mo., Wm. E. Woods.
WOAN, Lawrenceburg, Tenn., James D. Vaughan.
WOAR, Kenoshs, Wis., Henry P. Lundskow.

(Continued on next page.)

Corrected List of U.S. Stations Alphabetically by Call Signals

WOAS, Middleton, Conn., Bailey'e Radio Shop.
WOAT, Wilmington, Del., Boyd Martell Hamp.
WOAU, Evansville, Ind., Sowder Boiling Piano Co.
WOAV, Erie, Pa., Pa. Nat'l Guard.
WOAX, Trenton, N. J., Franklin J. Wolff.
WOAY, Birmingham, Ala., John W. Wilder.
WOAQ, Portsmouth, Va., Portsmouth Radio Ass'n.
WOAZ, Stanford, Texas, Penick Hughes Co.
WOC, Davenport, Iowa, 400 and 485 also Palmer School of Chiropractic.
WOE, Akron, Ohio, Buckeye Radio Service Co.
WOH, Indianapolis, Ind., Hatfield Elec. Co.
WOI, Ames, Ia., 485 also Iowa State College.
WOK, Pine Bluff, Ark., 485 also Ark. Light & Power Co.
WOO, Philadelphia, Pa., 400 and 485 also, John Wanamaker.
WOQ, Kansas City, Mo., 485 also Western Radio Co.
WOR, Newark, N. J., 400 only, L. Bamberger & Co.
WOS, Jefferson City, Mo., 485 also Mo. State Marketing Bureau
WOV, Omaha, Nebr., R. B. Howell.
WOU, Omaha, Nebr., Metropolitan Utilitiee.
WOZ, Richmond, Ind., 485 also Palladium Printing Co.
WPA, Fort Worth, Texas, 485 also Fort Worth Record.
WPAA, Wahoo, Neb., Anderson & Webster Elec. Co.
WPAB, State College, Pa.
WPAC, Okmulgee, Okla., Donaldson Radio Co.
WPAD, Chicago, Ill., Wieboldt & Co.
WPAF, Council Bluffs, Iowa, Peterson'e Radio Co.
WPAG, Independence, Mo., Central Radio Co.
WPAH, Waupaca, Wis., Wisconsin Dept. of Markets.
WPAJ, New Haven, Conn., Doolittle Radio Corp.
WPAK, Fargo, N. D., North Dakota Agricultural College.
WPAL, Columbus, Ohio, Superior Radio & Tel. Equip. Co.
WPAM, Topeka, Kane., Awerbach & Guettel.
WPAN, Houston, Texas, Levy Bros. Dry Goods Co.
WPAR, Beloit, Kans., R. A. Ward.
WPAT, El Paso, Texas, St. Patrick's Cathedral.
WPE, Kansas City, Mo., Central Radio Co.
WPG, New Lebanon, Ohio, 485 also Nushawa Poultry Farm.
WPI, Clearfield, Pa., Elec. Supply Co.
WPJ, Philadelphia, Pa., St. Joseph'e College.
WPM, Washington, D. C., Thos. J. Williams, Inc.
WPO, Memphis, Tenn., United Equip. Co.
WQAB, Springfield, Mo., Southwest Missouri State Teachers' College.
WQAK, Dubuque, Iowa, Appel-Higley Elec. Co.
WQAL, Mattoon, Ill., Cole County Tel. and Tel. Co.
WQAP, Lincoln, Nebr., Am. Radio Co.
WQAQ, Abilene, Texas, West Texas Radio Co.
WQX, Chicago, Ill., Riverview Park, Walter A. Kuehl.
WRAA, Houston, Texas, Rice Institute.
WRAN, Waterloo, Iowa, Black Hawk Elec. Co.
WRAU, Amarillo, Texas, Daily News.
WRAY, Scranton, Pa., Radio Salee Corp.
WRK, Hamilton, Ohio, Doron Bros. Elec. Co.
WRL, Schenectady, N. Y., Union College.
WRM, Urbana, Ill., Univ. of Ill.
WRP, Camden, N. J., Federal Inst. of Radio Telg.
WRR, Dallas, Texas, 485 also City of Dallas, Police and Fire Signal Dept.
WRW, Tarrytown, N. Y., Koenig Bros., Tarrytown Radio Research Lab.
WSAJ, Grove City, Pa., Grove City College.
WSAS, Lincoln, Nebr., State of Nebr.
WSAV, Houston, Texas, C. W. Vick Radio Const'n Co.
WSB, Atlanta, Ga., 400 and 485 Atlanta Journal.
WSL, Utica, N. Y., J. & M. Elec. Co.
WSN, Norfolk, Va., Shipownere' Radio Service.
WSX, Erie, Pa., Erie Radio Co.
WSY, Birmingham, Ala., Alabama Power Co.
WTAC, Johnstown, Pa., Penn. Traffic Co.
WTAU, Tecumeeh, Neb., Ruegy Battery & Elec. Co.
WTAW, College Station, Texas, Agricultural and Mechanical College of Texas.
WTG, Manhattan, Texas, Kane. State Agri. College.
WTP, Bay City, Mich., Ra-Do Corp.
WVP, New York, N. Y. Signal Corps, U. S. Army.
WWAC, Waco, Texas, Sanger Bros.
WWAX, Laredo, Texas, Worman Bros.
WWB, Canton, Ohio, Daily News Printing Co.
WWI, Dearborn, Mich., Ford Motor Co.
WWJ, Detroit, Mich., 400 485, Evening News.
WWL, New Orleans, La., Loyola Univ.
WWX, Washington, D. C., Post Office Dept.
1XAD, Pawtucket, R. I., Standard Radio & Elec. Co.
2XAI, Newark, N. J., Westinghouse Elec. & Mfg. Co.
2XI, New York City, A. T. & T. Co.
2XJ, Deal Beach, N. J., Amer. Tel. & Telg. Co.
3XW, Parkersburg, Pa., Horace A. Beale, Jr.
3YN, Washington, D. C., Nat'l Radio Inst.
9ARU, Louisville, Ky., Darrell A. Downard.

Weather Broadcasting

By Washington Radio News Service

RADIO telegraphy, although an invaluable factor for several years in receiving and sending data on weather to and from ships, was not recognized until recently as a medium for the general dissemination of forecasts, writes Prof. C. F. Marvin, Chief of the U. S. Weather Bureau, in his report to Secretary of Agriculture Wallace.

The use of radio by the bureau throughout the country was limited because of the necessity of using code, he explains. "With the introduction of radio telephony, which makes it possible for anyone to receive the message in spoken words, the broadcasting of information over the interior has increased enormously," he declares. A year ago the daily forecasts of the Weather Bureau were broadcast from 12 stations in seven states, principally by radio telegraphy, whereas on July 1, 1922, 98 stations in thirty-five states were carrying daily weather forecasts and warnings chiefly by radio telephone.

All broadcasts are sent out from Governmental, commercial and private stations, at no expense to the bureau. A special wave of 485 meters has been assigned by the Department of Commerce, and to avoid interference and duplication, only two stations in a city are licensed to transmit the weather information, although many others would gladly cooperate. It is estimated that at the end of the year twenty-five per cent of the licensed broadcasting stations were engaged in distributing this valuable meteorological information. The broadcasts are supplied the radio stations from neighboring meteorological stations by telephone. Undoubtedly the service could be placed on more efficient basis and materially extended, the Chief of the bureau states, if funds were available for telegraphing information to radio stations not now included in the system, and engaging more employes.

The value of radio-telegraphy in this special service has been demonstrated, Professor Marvin declares, pointing out that its future usefulness "cannot be estimated." Farmers by the thousands who do not get a forecast service by the telegraph or through the daily press and for whom code broadcasting was of little use installed receiving sets during the year. They now obtain the weather forecasts and warnings, so important in their occupations, as promptly as do business interests in urban communities. A great future increase in rural receiving stations is inevitable, the weather officials believe.

Another important accomplishment in radio work during the past year was the inaguration of a program of broadcasting the twice daily forecasts, cold wave, frost and other warnings and information issued for the states lying in the Chicago and Washington forecast districts. From April to November a summary of weather conditions as they affect the crops during the week preceding is also included. This service began in June, 1922. Radio-telegraphy and high wave-lengths are utilized, as telegraphy is more reliable for long range transmission. The radio receiving stations, equipped for high wave reception, receive a direct service thereby, and local radio-phone stations are enabled to broadcast for their districts. Material extensions were also made during the year in the radio bulletin service for the benefit of marine and aviation interests. The Chief of the Weather Bureau is gracious in his thanks to the officials of the Naval Communications Service for assistance rendered.

TO BROADCASTERS:

Please fill out and send to Radio Age, 64 West Randolph Street, Chicago, the following blank, so that your station may be accurately listed in our roster of broadcast stations from month to month. You will find this data is eagerly followed by fans everywhere and the service costs you nothing.

For Publication.

Our station call letters are.....

City.....State.....

Wave Length.....Radius.....

Nature of program and hours.....

.....

.....

Station Owned by.....

Station Operated by.....

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N. A. A. Starts in New Year

NAA, the great Naval Radio Station at Radio, Va., near Arlington, becomes the Government's chief broadcasting station for official information on January 3. On that date, all regular broadcasting previously handled by NOF, the radio experimental station of the Navy at Anacostia, will be transferred. Thereafter NOF will resume its experimental and research work, which may include the broadcasting of the Navy and Marine Band music in the interest of modulation tests.

A special wave length of 710 meters from the Government and public broadcasting band has been assigned to NAA by Secretary Hoover on December 15, at the request of the Inter-Departmental Radio Committee. This was done in order that the several regular circuits of the Army and Navy located there may be operated simultaneously without interference which occurred when phone broadcasting was undertaken on the lower governmental wave lengths from the main antenna.

The new radiophone transmitting set was especially made for NAA at the Naval Radio Laboratory at Anacostia. It is based on the master oscillator, power-amplifier system, and employs six 250 watt tubes, giving an output of 1 1-2 K. W. The apparatus is arranged so that the waves from 400 to 2,200 meters can be used in transmitting and the power is derived from a 2 K.W., generator. When transmitting on 710 meters, a special single wire antenna stretched from the top of one of the 400 foot towers is used. This new circuit does not interfere with any of the other circuits although used simultaneously. The height of the antenna gives practipractically the same efficiency as the low-lying, multiple-tuned antenna used at Anascostia.

When transmitting on the high-wave length, 2,050 meters, the large antenna will be used and other circuits will be interrupted temporarily. The design of this special set will permit of excellent modulation for the sending of speech and even music, Naval radio engineers say.

Transmitting ranges will vary with the season and in the day and night, but it is expected that a range of several thousand miles can be attained in night time transmission during the winter months, although this may fall off in the day time sending during the summer months to a 250 miles radius.

Recent broadcasts of the President's congressional address are reported to have been heard as far west as Chicago and Detroit, which speaks well for the work of NOF on 427 meters. Basically the new set for Arlington is built up on the results of radio-telephone broadcasting experiments conducted from Anacostia and a knowledge gained from the operation of the well-known set at NOF.

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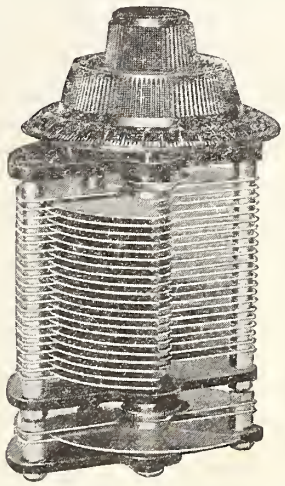

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Crystal Sets Hold On

There is a movement, particularly in large centers of population, toward the use of crystal sets in preference to vacuum tube sets.

In the case of the vacuum tube set, radio fans are familiar with all the difficulties that are encountered. When either the "A" battery or the "B" battery runs down, there is trouble and the trouble is not so easy for the amateur to find. When tubes burn out, there is additional expense—and just before they burn out, there is a great deal of distortion, which prevents the hearer from receiving a perfect rendition of what is going on at the broadcasting station.

In the case of the crystal set, however, the buyer makes his purchase for $15.00 or $25.00, strings up his aerial, connects his ground lead, adjusts the crystal and immediately is able to "listen in." While it is true that greater distance than 25 to 50 miles in not obtainable, nevertheless, that which is heard over the crystal set is an absolutely faithful and actual rendition of the voice or music at the broadcasting station. There is no oscillation, squeaking or squealing, which is so characteristic of regenerative tube sets.

Many radio enthusiasts have several types of sets in their homes and it is often a fact that when an important speech or symphony concert is being broadcast from a station 25 to 50 miles from the operator's home, the operator connects up his crystal set rather than the vacuum tube set. With a good pair of telephones to his ears and with a good make of crystal set, the operator can hear perfect exactness the tone quality of music with all its beautiful shadings or he can hear the voice intonations and enunciation of the speaker in a manner quite unobtainable with tube reception.

All this costs him no more than $15.00 to $25.00 for a complete outfit, including antenna equipment and telephones. There are no replacements, nothing to wear out, no batteries to re-charge, no tubes to be bought and if he is satisfied with receiving the nearby stations, his set should cost him practically nothing for upkeep.

On the subject of crystal sets, it should be noted that there are on the market crystal sets with a wave length range from 180 to 3,000 meters. Most of the old type sets have a wave length range of 150 to only 800 meters and some even as low as 500 meters. As soon as Congress passes the new law recommended by the Radio Board, broadcasting will be done on much higher wave lengths and several stations can be operated in the same locality at the same time, so that a good crystal set should have a wave length range at least going up to 2,000 meters and will be able to receive the broadcasted material which will undoubtedly be sent on higher wave lengths than the 360 meter wave length, to which they were formerly restricted.

Most crystal sets do not have a variable condenser and this should be compensated for by having two binding posts on the crystal set, one for long antenna and one for short antenna. The former should have an antenna condenser connected in series with the aerial lead. In fact, a variable condenser does not give maximum efficiency in a crystal set.

Tapped coils are usually preferable to sliding tuners, as sliding tuners frequently wear out or become short circuited. A tapped coil set is a life long investment. With two binding posts, one for long antenna and one for short antenna, the operator will be able to accommodate his set to the conditions possibly limited and to which his antenna can be erected.

There are good crystal sets on the market embodying these features with a tapped coil and variometer adjustment for fine tuning. With the variometer, the price is usually in the neighborhood of $25.00,—the variometer being built into the set and two binding posts provided for different antenna lengths. The $15.00 sets do not, as a rule, have any other adjustment than the tapped coil. The buyer should select one with a wave length of at least 2,000 meters, otherwise, this winter, he will not be able to get broadcasting at a higher wave length.

What Hoover Says Radio Needs

(*Continued from page 15.*)

radio wave lengths, especially those used between ship and shore stations, is pointed out by Secretary Hoover in his report, attention being called to the fact that the last conference was in 1912 when the United States had but one trans-oceanic station in operation. This matter, however, has the attention of the State Department, which is now organizing the personnel of a representative governmental committee to draw up agenda for the next international convention on electrical communication to be held at Paris next spring.

In summing up Mr. Hoover says: "To close an efficient administration of the radio service is imperative if we are to maintain its efficiency as a life-saving agency on shipboard, a means of commercial communication, and of instruction and entertainment for our people. To perform this work we must have an experienced and expert personnel. To secure and retain such men the service must be provided with adequate funds to meet the increasing demands of commercial enterprises for qualified men."

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Radio at Sea

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For ships' call letters see International Radio Call Letter List or List of Radio Stations of the United States.

Radiograms requesting medical advice should be signed by the captain of the ship and should state briefly, but clearly, the symptoms of the person afflicted. Such radiograms should be addressed "Unifruitco" (name of place) and may be sent to any of the United Fruit Company's hospitals listed below:

Santa Marta, Colombia.
Port Limon, Costa Rica.
Almirante, Panama.
Tela, Honduras.
Puerto Castilla, Honduras.
Puerto Barrios, Guatemala.

All United Fruit Company passenger steamships carry doctors, and free medical service may be procured by radio from any of them by a radiogram addressed "Ship's Doctor," followed by the name of the steamship. This free medical service is established, primarily, for the benefit of ships not carrying doctors. However, should occasion require, ships' doctors may hold consultation by radio with the United Fruit Company ships' doctors and hospital staffs. The physicians and surgeons comprising the medical staff of the United Fruit Company and its subsidiaries are thoroughly qualified, but in view of the fact that radio medical advice to ships at sea is given free and without an opportunity for a personal examination of the patients by them no responsibility will be assumed by either the company and its subsidiaries or the physicians or surgeons giving the advice as to its accuracy or for error in the receipt or transmission of any message sent or received in connection therewith. It is requested that when sending medical advice radiograms radio operators check them "(number of words) DH Medico." "DH Medico" radiograms will be given preference over all other radiograms, excepting SOS calls, throughout the radio service of the United Fruit Company and subsidiary companies.

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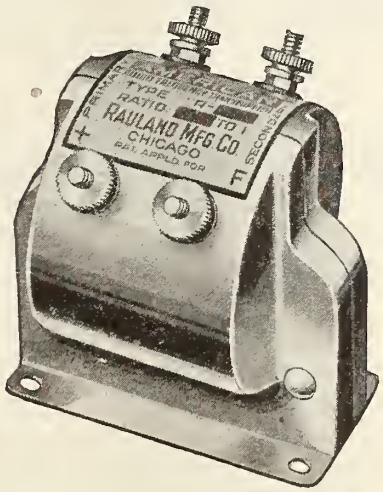

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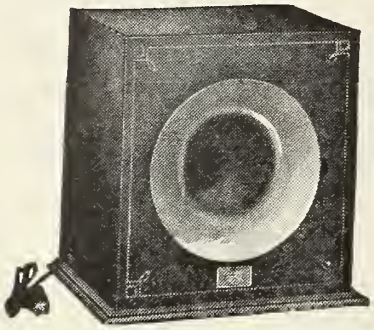
The Plan-O-Phone is the most amazing value of any Radio Loud Speaker on the market. Remarkable acoustics. Used with any 2 stage amplifier receiving set. Fits any receiver. Made of statuary bronze—handsome, durable. Special insulating device. Nothing half so good at several times the price. Ask your dealer to show it. Mfd. and guaranteed.

$3.50 sent prepaid if your dealer can't supply you.

The Planet Radio Loud Speaker

Price each, $40 00



Weight 2½ lb., 11 in. high, Bell diam. 6 in.

Perfect Sound Reproduction

The Planet Loud Speaker marks the *most advanced step* in the perfection of Receiving Radio Broadcasting. Radio experts, "fans" and dealers, *all* are amazed at the remarkable fidelity with which the PLANET fills a room with the exact tonal qualities of the human voice, musical instruments, etc. The PLANET is a *complete unit*. Like a thing of magic it transforms the ordinary 2 stage amplifier receiving set into a wonderful musical instrument. Beautiful design, richly finished mahogany case and polished emitter with gold or aluminum finish, make the PLANET an ornamental attraction to any home. Loud, distinct, clear reproduction. Price $40.00.

The Planet Power Amplifier

Price $27.50 (without tube)

An essential unit for receiving sets that do not produce sufficient volume. Constructed so that either a five-watt power tube or amplifying tube can be used depending upon the volume desired. An article of the highest grade. It is *equipped with special units found in no other amplifier*. With the Planet Amplifier you can greatly increase your volume without distortion. Every detail of construction shows the highest grade workmanship and materials.

DISTRIBUTORS

BOSTON—Beaudette & Graham Co., 915 Boylston St.
BALTIMORE—Jones Elec. & Radio Mfg. Co., 118-20 E. Lexington St.
DETROIT—B. E. Polczynski & Co., 304 Capitol Theatre Bldg.
GRAND RAPIDS, MICHIGAN—Wolverine Elec. Corp., 21 Division St.
KANSAS CITY, MISSOURI—Western Radio Co., 6 W. 14th St.
PEORIA—Diamond Elec. Sup. Co.
ST. LOUIS—The McGraw Co., 2018 Locust St.
NEW YORK CITY—Harold M. Schwab, Inc., 419 W. 42nd St.
NEWARK, NEW JERSEY—General Mdse. Co., 142 Market St.

Planet Radio Corporation
Dept. M1
1223 S. Wabash Ave. Chicago, Ill.

Description for a Loading Coil for Simple Set

(*Continued from page 12.*)

is thus entirely disconnected from the receiving set and should be removed some distance from it. The operation of the receiving set is then exactly the same as described in Circular No. 120. In order to receive messages transmitted at wave frequencies less than 500 kilocycles per second (wave lengths over 600 meters) the loading coil is again connected as shown in Fig. 1A and the switches on the loading coil panel are adjusted so that the proper number of turns is included in the circuit. The switches on the panel of the original receiving set are set so that they include all the wire on the coil, (i. e., set switch arm Y on contact point 10 and switch arm V on contact point 8, Fig. 1A. See also Fig. 3, p. 10, Circular No. 120). The switch D on the loading coil panel is set to the extreme left on contact O, and the switch arm C is rotated slowly over its entire range. If signals are not heard, the switch arm D is set on the next contact to the right and the switch arm C is again rotated over all of its contacts. If the signals are still not heard, the switch arm D is placed on the contact to the extreme right and the switch C again rotated over its contacts. When the transmitting station is heard, the signals may be improved by adjusting the right-hand switch arm V of the original receiving set, and the same time changing slightly the setting of the switch arm C.

Use With Two-Circuit Set.

The loading coil as described herein has been found quite satisfactory in extending the wave length range of the single-circuit receiving set. The experimenter may be interested to try various ways in which to extend the wave length range of the two-circuit set. For the general guidance of the experimenter, the following methods will give results, with varying degrees of satisfaction: Use of the loading coil in one of the two circuits and no loading in the other (this means that one of the circuits will not be tuned to the wave); use of loading coil in the primary, together with a fixed condenser (See Bureau of Standards article in this issue) in parallel with the variable condenser; use of loading coil in one of the two circuits and winding more wire on the coil in the other circuit.

Approximate Cost.

The parts listed below are those used in the loading coil. The receiving set parts are listed in Circular No. 120. The two sets of parts constitute a complete receiving equipment which has a rather wide range of wave frequencies as explained in the first part of this circular. The approximate cost of the complete equipment is therefore the sum of the amount given below and the amount given in Circular No. 120.

5 Ounces No. 28 copper wire, double cotton covered	$0.80
2 battery clips	.20
2 switch knobs and blades, complete	1.00
14 switch contacts, nuts and washers	0.60
1 cardboard box (5 3-8″ dia. x8″ long)	
3 binding posts	0.45
Wood for panel and base	
Paraffin	
Total	3.05

Fixed Condenser for Simple Sets

(*Continued from page 11.*)

shunt condenser has a capacity of approximately 0.0015 microfarad (1500 micromicrofarads).

Approximate Cost of Parts.

Series-Antenna Condenser.

2 metal strips (copper, brass or aluminum)	$0.10
3 sheets of mica (if used)	.20
1 binding-post (any type)	.10
6 wood-screws	.10
2 small wooden blocks	
Paraffin	
Paper	
Total	$0.50

Telephone-Shunt Condenser.

About 40 sq. inches of heavy tin-foil	$0.25
2 screws for mounting condenser	.05
2 small pieces of heavy cardboard or thin wood	
Paraffin	
Paper	
Total	$0.30

Radio Needs Trained Men

Radio is sweeping the country like wild fire. Thousands of dollars are being spent for expensive outfits. RADIO EXPERTS are needed everywhere to keep this equipment in order and to sell and install new outfits.

Be a Radio Expert

I will train you quickly and easily in your spare time, to become a RADIO EXPERT so you can install, construct, repair and sell Radio equipment. I am a **Graduate Electrical Engineer** and from actual experience I will give you exactly what you must know to make the really **big money in radio.**

FREE My Consultation Service to you is FREE. This outside help which I gladly give you is, in itself, worth more than the small cost of the Complete Course.

START NOW

Don't let others beat you to the big money. **Start now** and within a few weeks' time I will train you at home, at an amazingly low cost, to become a RADIO EXPERT. Write for **"Radio Facts"** sent **free** without obligation.

A. G. MOHAUPT, Electrical Engineer
American Electrical Association
Dept. E9, 4511 Ravenswood Ave. Chicago.

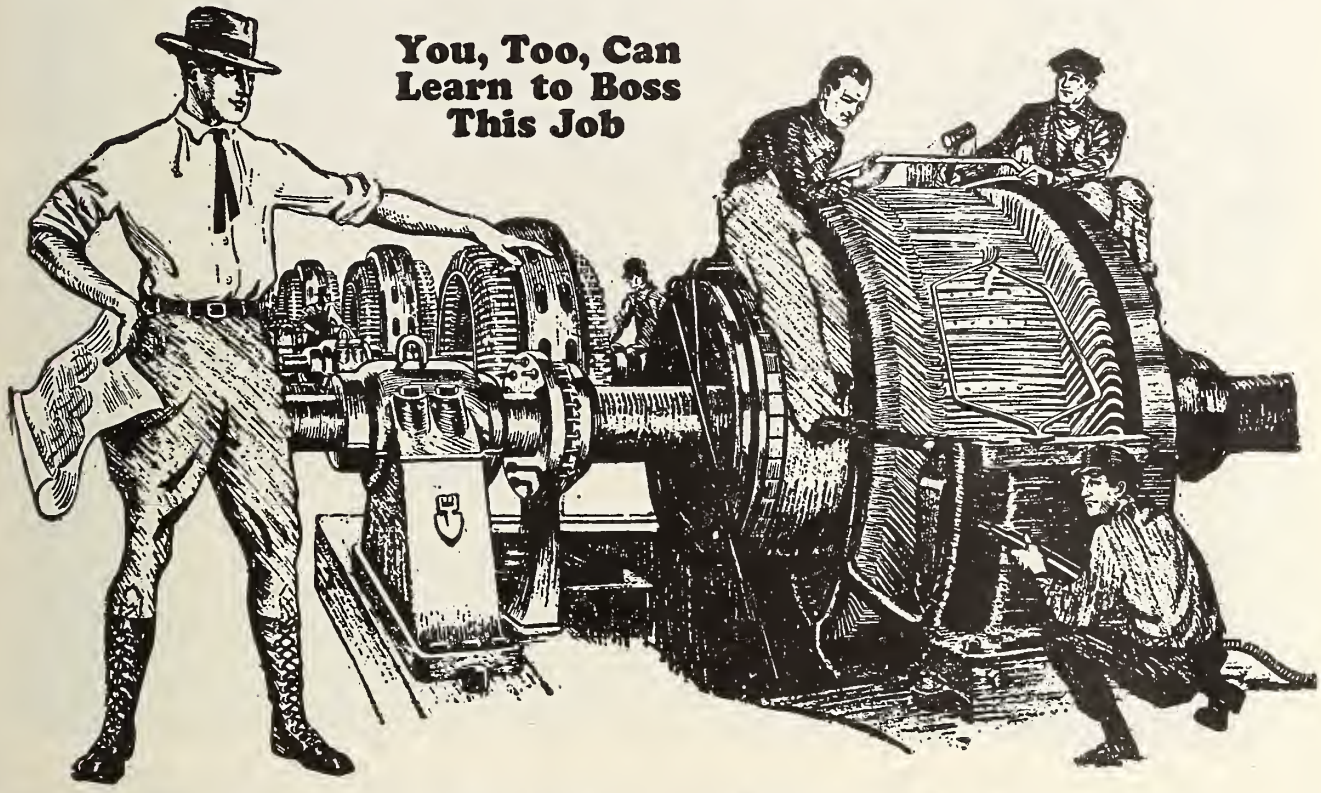
WRITE TODAY

RADIO MAILING LISTS

10,975	Radio Dealers covering U. S. by states per M.	$ 7.50
1,320	Radio Mfgrs. covering U. S. by states per list	12.50
1,325	Radio Supply Jobbers covering U. S. by States per list	12.50
260	Radio Stations per list	4.00
257	Mfgrs. who make and assemble complete Radio sets per list	4.00
25,000	Radio Amateurs & Managers of Radio Stations per M	7.50
3,000	Radio Amateurs & Managers of Radio Stations in Canada per M.	7.50
20	Radio Manufacturers in Canada per list.	1.50
87	Radio Supply Jobbers in Canada per list	2.50
131	Retail Radio Dealers in Canada per list	3.00
125	Mfgrs. & Jobbers & Retail Dealers in England per list	4.00

Ready to send on receipt of remittance.
TRADE CIRCULAR ADDRESSING CO.
166 W. Adams Street, Chicago.

Be a Certificated Electrical Expert



EARN $3500 to $10000 a Year

Trained "Electrical Experts" are in great demand at the highest salaries, and the opportunities for advancement and a big success in this line are the greatest ever known.

"Electrical Experts" earn $70 to $200 a week. Fit yourself for one of these big paying positions. In my twenty years of Electrical Engineering I have gathered some wonderful and interesting facts about this great industry — "Vital Facts." I will send them to you free.

Learn at Home to Earn $12.00 to $30.00 a Day

Today even the ordinary Electrician — the "screw driver" kind — is making money — big money. But it's the trained man —the man who knows the whys and wherefores of Electricity — the "Electrical Expert" — who is picked out to "boss" ordinary Electricians — to boss Big Jobs — the jobs that pay. You, too, can learn to fill one of these jobs— spare-time only is needed. Be an "Electrical Expert" — Earn $70 to $200 a week.

Age or Lack of Experience No Drawback

You don't have to be a College Man; you don't have to be a High School graduate. If you can read and write English, my course will make you a big success. It is the most simple, thorough, and successful Electrical Course in existence, and offers every man, regardless of age, education, or previous experience, the chance to become, in a very short time, an "Electrical Expert," able to make from $70 to $200 a week.

Some Features of My Course That Make SUCCESS Certain

1. Practical Money-Making Instruction—no useless, high-sounding theory.
2. Free Electrical Outfit. —Finest outfit ever sent out for home experiment and practical use.
3. Free Employment Service. (Helps you get a good job.)
4. Free Consulting Service. (No chance to get stuck on anything, while studying or afterward.)
5. Free Engineering Magazine.
6. Free use of my Electrical Laboratory.
7. Extra Courses Free— Radio—Electrical Drafting.
8. Spare Time Work— Special earn-while-you-learn lessons.
9. Reduced prices on all Electrical Supplies.
10. Cash Refund Guarantee Bond.

These features are all explained in my big Free Book.

I Give You a Real Training

As Chief Engineer of the Chicago Engineering Works, I know exactly the kind of training a man needs to get the best positions at the highest salaries. Hundreds of my students are now earning $3,500 to $10,000 a year. Many are successful ELECTRICAL CONTRACTORS.

Your Satisfaction Guaranteed

So sure am I that you can learn Electricity—so sure am I that after studying with me, you too, can get into the "big money" class in electrical work, that I will guarantee under bond to return every single penny paid me in tuition if, when you have finished my course, you are not satisfied it was the best investment you ever made.

FREE—Electrical Working Outfit —FREE

I give each student a Splendid Outfit of Electrical Tools, Materials and Measuring Instruments absolutely FREE. I also furnish them with all supplies, including examination paper, and many other things that other schools don't furnish. You do PRACTICAL work—AT HOME with this Outfit. You start right in after the first few lessons to WORK AT YOUR PROFESSION in a practical way.

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L. L. COOKE, Chief Engineer

Chicago Engineering Works

Dept. 1689 2150 Lawrence Ave., Chicago

Use this Free Outfit Coupon!

L. L. COOKE, Chief Engineer,
Chicago Engineering Works, Dept. 1689
2150 Lawrence Ave., Chicago, Ill.

Dear Sir:—Send at once the "Vital Facts" containing Sample Lessons, your Big Book, and full particulars of your Free Outfit and Home Study Course—all fully prepaid, without obligation on my part.

Name.....

Address.....

City and State.....

Occupation.....Age.....

The "Cooke" Trained Man is the "Big Pay" Man

3000 OHM SETS, $4-50

2000 OHM SETS, $4.00 1000 OHM SETS, $3.50

Plus 20c for Postage and Insurance.
Satisfaction Guaranteed or Money Back.

We mail phones the day your order arrives. Every pair tested, matched, and guaranteed as sensitive as $8 to $10 phones. We have no agents or dealers. By ordering direct you save dealer's profits—circular free.

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22 Station St.

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CLEAR

DURABLE

HERE'S THE CLIFTON DETECTOR

Why not get something worth while?

1. Crystals and contact points sealed in dustproof container.
2. No catwhiskers.
3. Simple to operate.
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Write at once for the detector extraordinary.
$1.50 Postpaid

THE CLIFTON MANUFACTURING CO.
NEWARK, NEW JERSEY
(Dealers write for proposition)

Look

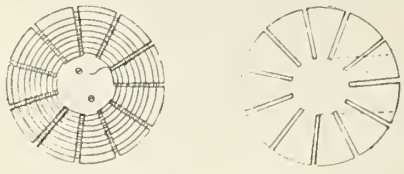
Spider Web Inductance and Discs

that give the wonderful results as described in Radio Age.

Inductance wound complete $2.00
Disc Only .. .. .50

Diagram for connections free with order.

We are manufacturers of Storage Batteries for Radio A and B circuit.



Write for Prices

INTERNATIONAL BATTERY CO.
112 Louis Street, N. W.
Grand Rapids, Mich.

Send $1.00 to Radio Age, 64 W. Randolph Street, Chicago, and receive this middle-west radio periodical for six months. Regular subscription price is $2.50 a year.

500,000 At Radio Wedding

AN UNIQUE wedding ceremony was performed when George Albert Carver, of Swissvale, Pa., and Miss Bertha Annie McMunn, of Pitcairn, Pa., were married recently in an especially constructed glass radio booth during the Pittsburgh Electrical Exposition at Motor Square Garden, Pittsburgh.

The occasion was the first time on record that a couple were married by radio, and the wedding was witnessed by one of the largest assemblages that ever attended such an event, for, in addition to the 10,000 persons who attended the electrical exposition to see and hear the public ceremony, several thousand more "listened in" on their radio receivers.

It is difficult to estimate the exact number of "wedding guests" but it is certain that at least 500,000 persons "attended," if not in person, at least by ear, the wedding of Mr. and Mrs. Carver, which was performed by the Rev. J. Hankey Colclaugh, pastor of the Pitcairn, Pa., Presbyterian Church.

The wedding was a part of an electrical exposition held in Pittsburgh, in November. News of the radiophone wedding ceremony had been broadcasted for weeks before and also had appeared in all the Pittsburgh newspapers. As a result, when the couple, with their attendants and parents, appeared at Motor Square Garden for the ceremony they found the large hall packed with an eager throng and many thousands clamoring vainly for admission.

The ceremony was held in an especially constructed sound-proof glass booth, which, as the illustration shows, permitted an unobstructed view of the ceremony. This glass booth contained a radiophone pick-up connected by direct telephone line with the powerful Westinghouse radiophone station, KDKA, at East Pittsburgh, about nine miles away. In this manner, words spoken in the glass booth were broadcasted by the KDKA broadcasting apparatus.

A large receiver was also installed in a hotel across the street from Motor Sqaure Garden, and to this was attached in parallel a number of loud speakers. This radio receiver picked-up the message broadcasted from KDKA and the loud speakers multiplied its volume ins de the hall. By this arrangement, the audience at the electrical exposition could see a man speaking and hear his address by radio at the same time.

This unique arrangement was what made the wedding a history-making event. Nothing like it had ever been done before and, of course, it attracted an enormous crowd.

As the bridal party entered the booth on the night of the wedding, the KDKA orchestra, sitting in the broadcasting studio nine miles away, started the wedding march. The strains of this beautiful music came in clearly through the loud speakers in the exposition hall.

The minister then took his place with his back towards the crowd assembled below and, with the bride and groom and their attendants grouped on either side of the transmitter, the ceremony started.

It was soon finished, but during the brief form not a sound was made by the 10,000 or more persons who had assembled to witness it. The glass booth was the object of all eyes and the loud speakers the only audible sound.

There was something weird about the whole ceremony. Spreading out above the audience were the rows of brightly lighted booths. To the rear was a completely equipped electrical home, shining in its newness. Directly in front was an electric fountain, playing its myriads of flashing lights and changing colors upon the scene. The whole picture was shortlived but wonderful while it lasted. Directly the ceremony was over, the bride and groom bowed and then dashed from the booth to start their honeymoon journey.

As a wedding gift, the exhibitors at the electrical exposition gave the couple every domestic electrical appliance possible to use in a home. More than $1,200 worth of electrical appliances, which included among other things, an electric range, a dishwasher, table lamp, desk lamp, iron, hot plate, vacuum sweeper, toaster, washer, toaster stove, table stove, waffle iron, curling iron, cup heater, and other suitable gifts, were placed in a special booth and delivered to the couple after the ceremony.

Send$1.00 to Radio Age, 64 W. Randolph Street, Chicago, and receive this middle-west radio periodical for six months. Regular subscription price is $2.50 a year.

"SENSITONE" Regenerative Radio Receiving Set

$15

DOWN AND $10.00 PER MONTH

Immediate Shipment

Manufactured under Armstrong License, U. S. patent No. 1,113,149 and pending letters of patent No. 807,388.

READ THESE TESTIMONIALS!

Seaton, Ills., December 22, 1922.

Harold R. Waken Co.
Chicago, Ills.

Dear Sirs:

Following is a report of the different stations I received on the Sensitone Detector, and all came in very clear, on the 21st.

Ft. Worth, Texas	Memphis, Tennessee.
Davenport, Iowa.	Dallas, Texas.
Cincinnati, Ohio.	St. Louis, Mo.
Indianapolis, Ind.	Louisville, Ky.
Pittsburg, Pa.	Schenectady, N. Y.
Kansas City, Mo.	Denver, Colo.
Chicago, Ills.	Newark, N. Y.
Atlanta, Ga.	Detroit, Mich.
	Minneapolis, Minn.

I did not go to bed until 3 a. m. next morning. Certainly is a fine machine. Hope to add Amplifiers and Loud Speaker in near future. I am getting stations that other radio bugs here in town don't get. 12 radio sets in town at present. 400 population, and lots of bugs here. You can use my name if you choose.

Yours truly,

D. E. HAIST,
Telegrapher, M. & S. T. L. R. R. Seaton, Ills.

Harold R. Wakem and Co.,
Chicago.

Dear Sirs:

Last night was the first night that I tried my Sensitone, and here are some of the stations that I heard very well: Houston, Texas; Denton, Texas; Fort Worth, Texas, St. Louis; Dallas News; Cincinnati; Atlanta Journal, Detroit News.

I heard ever so many others, that I just tuned in or out as they interested me or not. Now, don't you think that's a good start for a green beginner? According to what I have read I am living in the "home" of static, and I am sure there was lots of it yesterday, as it was very warm, and we had a lighting storm also.

I listened in to the St. Louis Post-Dispatch for over an hour, as their concert was fine, and everything was clear. Yesterday afternoon at three I heard Houston, Tex., very well.

Detroit is a mighty long distance from here, so I consider your set a marvel.

With all good wishes for the coming season I beg to remain Yours sincerely.

REV. JOS. J. BOUDREAUX.

December 13, 1922, 9:49 p. m.
DB 841, 49 Collect NL., Lubbock Tex 13
Harold R. Wakem & Co., Chicago, Ill.

In answering queries relative distance performance be explicit without fear quote this telegram first night's program included Detroit News, Drake Hotel, Chicago, Kansas City, Davenport, Atlanta, Paducah, Ky., Los Angeles, San Antonio, Houston, Ft. Worth, Oklahoma City, entire cotton, cattle, hog, sheep markets from Kansas City. Two p. m.: Is more than satisfactory with thirty foot aerial. W. H. WARD. Theriot, Louisiana, December 16, 1922.

ONLY 500 SETS SOLD ON THE EASY-PAY PLAN

We are making this rather costly investment in order to get 500 sets in the hands of that number of influential families, so that, when we put our goods in the hands of dealers, they may have enthusiastic SENSITONE boosters nearby to whom they can refer their future prospective buyers.

Fill out the coupon, attach check or money order for $15.00. Set will be shipped at once by express. Those who delay will be too late.

Harold R. Wakem & Co.
900 Washington Blvd. CHICAGO

HAROLD R. WAKEM & CO.,
900 W. Washington Blvd., Chicago, Ill.

Enclosed you will find $15.00 as first payment, upon receipt of which you will send me your complete Sensitone Radio Receiving Set, as described above. After I have used the set for thirty days, I agree to send you $10.00 and the same amount every thirty days thereafter, until the full purchase price of $95 is paid. This set is to remain the property of Harold R. Wakem & Co. until payments are completed.

Signed.....

Street address.....

City.....

In the spaces below give the names of two references, (banks or business houses preferred).

Name and Address.....

Name and Address.....

Burgess, the *Radio* Battery
—construction fully patented

When you buy a Burgess "B" Battery you get more than long life, noiselessness, high capacity and moderate price. You get also Burgess special radio construction, perfected by wireless specialists and fully patented! This exclusive ***radio*** construction is found in no other battery on the market to-day.

What does this mean to users of radio batteries? It means clear receiving. It means lowest cost per hour of service. It means long shelf life and highest current capacity. It means that Burgess "B" Batteries are the best radio batteries it is possible to produce. Don't take our word for it—***ask any radio engineer.***

Leading manufacturers of radio equipment specify "Burgess." Burgess "B" Batteries are handled by all progressive jobbers and dealers. "Look for the Black and White Stripes." And if your dealer doesn't handle Burgess "B," just address:

BURGESS BATTERY COMPANY

Engineers—Dry Batteries—Manufacturers

Offices and Warehouses at:

CHICAGO, ILL., 111 W. Monroe St. NEW YORK, N. Y., 50 Church St. BOSTON, MASS., 136 Federal St.
ST. PAUL, MINN., 2362 University Ave. KANSAS CITY, MO., 2109 Grand Ave. MADISON, WIS., Main and Brearly Sts.

In Canada: BURGESS BATTERIES, Ltd.
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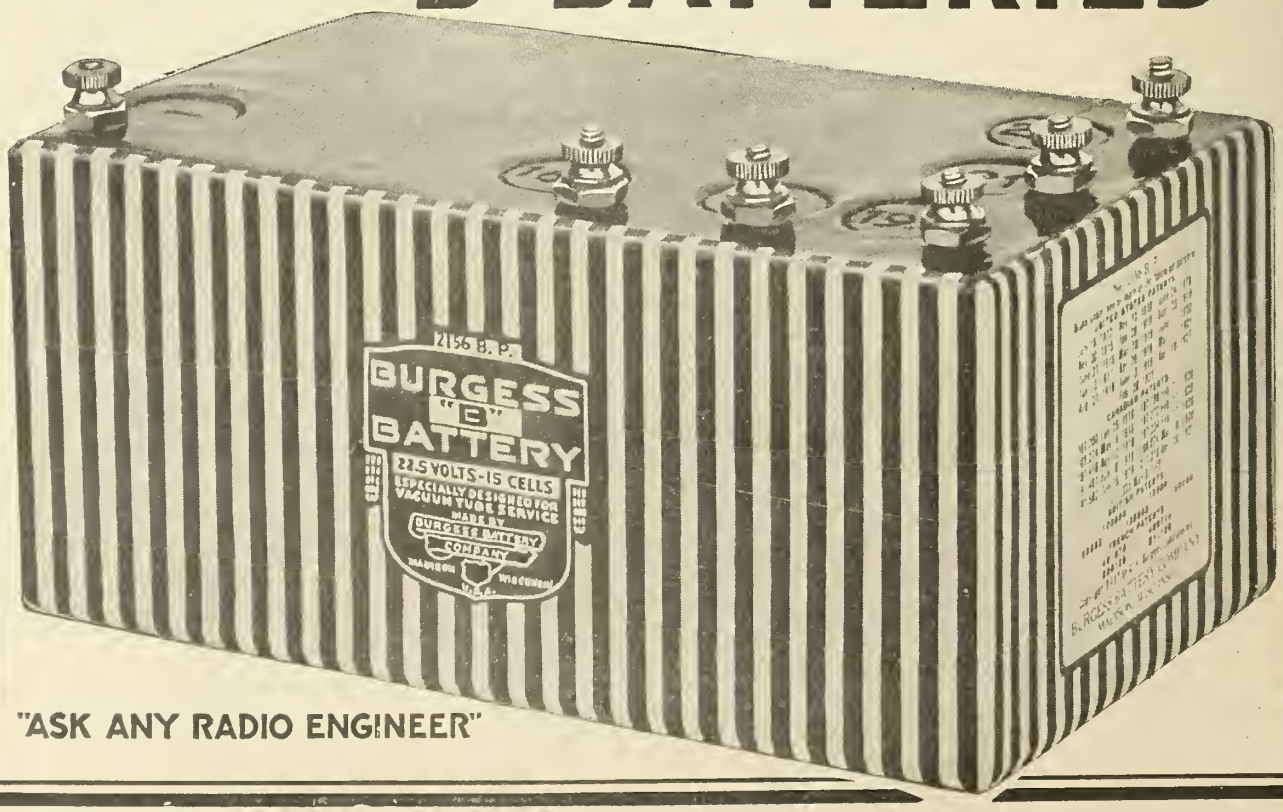


"ASK ANY RADIO ENGINEER"

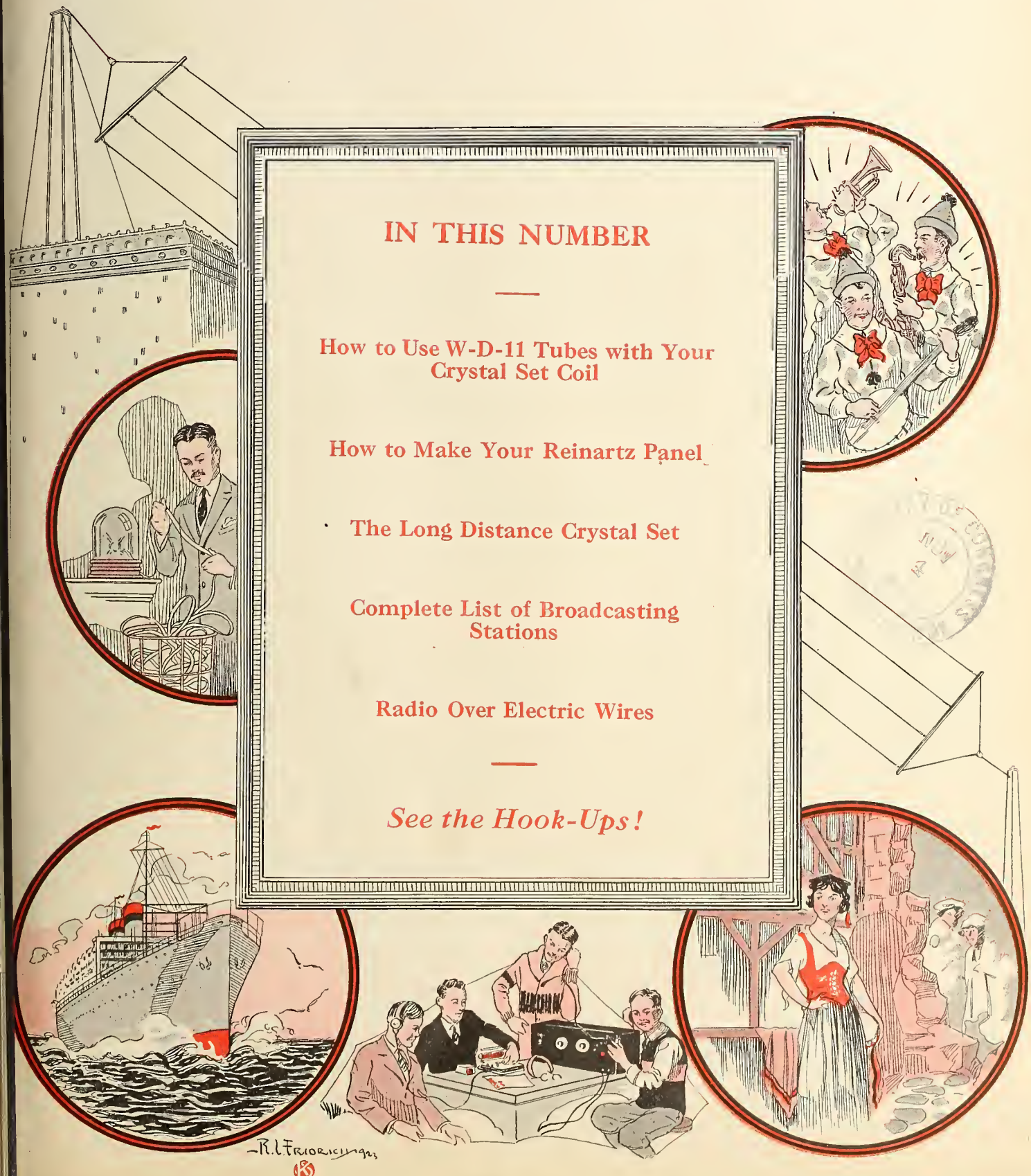
REINARTZ CIRCUITS—SEE BACK COVER ANNOUNCEMENT

RADIO AGE

The Magazine of the Hour

March, 1923

Price 25 cents



IN THIS NUMBER

How to Use W-D-11 Tubes with Your Crystal Set Coil

How to Make Your Reinartz Panel

The Long Distance Crystal Set

Complete List of Broadcasting Stations

Radio Over Electric Wires

See the Hook-Ups!

RADIO AGE INSTITUTE

To insure 100% value to readers of advertisements, as well as 100% value to the advertisers themselves, radio equipment is now being tested and indorsed by the

RADIO AGE INSTITUTE

64 WEST RANDOLPH STREET
CHICAGO, ILLINOIS

No charge is made for testing and approval, and all merchandise will be returned as soon as possible, transportation expenses to be paid by the manufacturer. Lists of makers of approved radio goods will be published from time to time.

SERVICE DEPARTMENT FOR READERS

Please remember that Radio Age has one of the best radio instructors in the United States, who is ready to answer any technical question. This costs you nothing.

RADIO AGE

The Magazine of the Hour

Volume 2 *MARCH, 1923* *Number 2*

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6

Six Reasons

THIS magazine has taken a place as one of the most popular of radio publications for six very good reasons:

1—It publishes each month a complete, corrected list of broadcasting stations, with program schedules. These stations are listed alphabetically by call numbers for ready reference by radio owners.

2—This magazine is the official news medium for the National Broadcasters' League, a nation-wide organization which added sixteen big broadcasting stations to its membership in the last month. Radio owners are interested in broadcasters and broadcasting and they are quick to recognize our leadership in this department.

3—Frank D. Pearne, chief instructor in electricity at Lane Technical High School. Chicago, is technical editor of Radio Age, He made the Reinartz tuner famous with his illustrated Reinartz articles in Radio Age. He writes radio with a peculiarly clear understanding of his subject and a peerless conception of what the radio public wants to know. He makes the masses understand.

4—Elementary radio is fully illustrated by the most accurate of diagrams and drawings. Simplicity in the treatment of the most difficult phases of radio has won the favorable attention of radiowners everywhere.

5—We are publishing the magazine for our readers. We call attention to the columns of letters in this issue written to us by fans in all parts of the country giving their reception records, describing their hook-ups and giving details as to aerial arrangement, amplification, etc. This is reader interest, demonstrated conclusively.

6—This magazine devotes much time and space to all phases of radio, its growth, its needs, its protection, its importance. It aims at constructive treatment of radio in all its departments. It tells the truth about radio and like Andy Gump it "wears no man's collar."

6

Grand Opera a Boon to Radio

THE Chicago Civic Opera Association in January finished one of the most successful seasons ever experienced in Chicago—a season devoted to popular prices which were responsible for packed houses every night during the entire run of ten weeks.

At the same time, KYW, one of the four large radio stations, operated by the Westinghouse Electric & Manufacturing Co., and the only station in the world to broadcast grand opera, also concluded the most important, instructive, and entertaining feature of its daily twelve-hour schedule. During the entire season KYW put in the air productions of the best known operas two nights each week, by courtesy of the Chicago Civic Opera Association, whose hearty cooperation made this feature possible.

During this ten weeks' run of the opera in Chicago thousands of letters were received at the Westinghouse office, carrying words of commendation and thanks from every state in the Union, the majority of the letters having been received from people residing in the more isolated districts of the United States. Station KYW, by broadcasting the more famous works of the great masters, has done much to develop a greater appreciation of classical music among the residents of the United States.

The broadcasting of grand opera was made possible by the installation of special sealed telephone wires in the Auditorium Theatre, connecting the huge theatre directly with the station. Three microphones then picked up the music of the productions as they were produced on the stage. The music then passed over the special wires to the transmitting equipment in the station where it received the proper modulation for broadcasting and was sent out into the ether waves to be tuned in by millions of enthusiastic owners of receiving sets.

KYW now has the reputation of being the only station in the world to broadcast grand opera. This year radio has given the people of the United States, who are fortunate enough to own receiving sets, an opportinity to hear the brilliant interpretation and singing of Virgilio Lazzari in "Aida," Ina Bourskaya, as Amneris in "Aida,"

Giacomo Rimini, in "The Barber of Seville," and Claudia Muzio in the role of Aida, in the opera of that name.

Picture sitting comfortably at home in your favorite arm chair, listening to the beautiful voices of such internationally famous singers as those just named, and you are visualizing the principal cause for the popularity of opera as broadcast by KYW.

The announcer at KYW, the other evening, addressed his great audience on the subject of difficulties overcome by the expert staff which operates a big transmitting station. He pointed out that opera was one of the most difficult things to broadcast for the reason that the singers are at various distances, and that special arrangement has to be made to "pick them up" wherever they may be upon the stage.

It was necessary, therefore, for the man in charge to have ten microphones stationed on the stage and near the orchestra pit. Different microphones were used for solos and for orchestra numbers. The operator must know the operas thoroughly so that he may be able to make quick shifts, being always aware of what is coming next.

RADIO AGE
"The Magazine of the Hour"
M.B. SMITH PUBLISHER
PUBLISHED MONTHLY GARRICK BLD'G CHGO.
FREDERICK SMITH EDITOR

Layout and Drilling for Reinartz Tuner with Amplification

By **F. D. PEARNE**

SO MANY of our readers have requested information regarding the layout of panels for the Reinartz tuner that we are giving full instructions for same in this issue. Many different arrangements have been shown in various magazines and papers, some of which work out and some do not. This layout is the standard arrangement, designed by the writer and used on more than one hundred sets that have been built under his supervision, so that there is no question about how it will work out.

The panel should be made of bakelite, or hard rubber, 18 inches long, 8 inches wide, and 3-16 of an inch thick. While this arrangement provides for the tuner and one stage of radio and one stage of audio frequency, or the tuner and two stages of audio frequency, as desired, it can also be used for the tuner only, leaving the other two stages blank, until the builder wishes to add to the set.

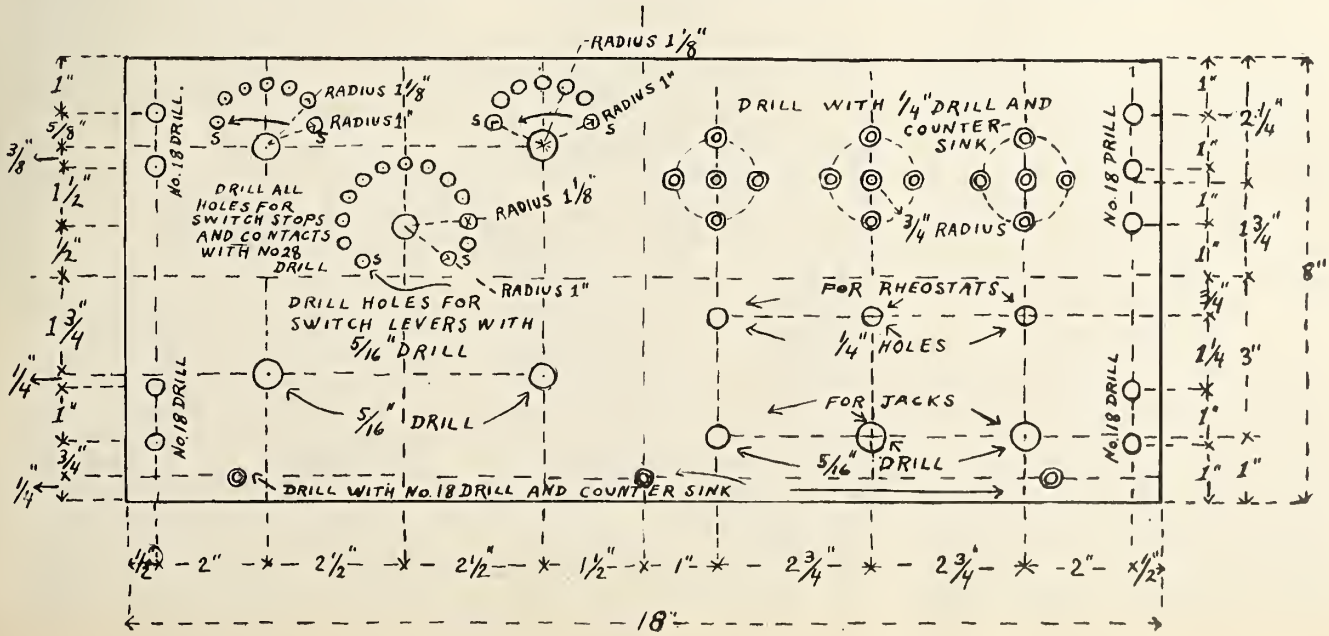
The primary idea is to furnish space for the entire combination in a condensed form, which may be added to later on. The holes on the extreme ends of the panel are to be used for the binding posts. The two at the top of the left hand end are for the aerial and ground, while the two at the bottom of the left hand end are used for the positive and negative of the "A" battery. The three binding posts at the righe end of the panel, at the top, art used for the terminals of the "B" battery, the top one being connected to the negative, the center one to the 22 1-2 volt positive, and the lower one to the 45 volt positive.

The two lower posts on the right hand end are used for a loud speaker connection, or for an extra set of head phones. In drilling the holes for the switch contacts, the radius is given as 1 1-8 inches. This of course provides for switch levers of this length which is standard, but as there are several other standard sizes, it would be well to purchase the switches first, as it may be possible that the dealer may not have this size in stock and it might be necessary to use a different radius to fit the particular switch lever obtained.

It will also be noticed that two of the holes in each switch layout are marked "S." These particular holes are to be used for the stops for the switch lever and should be set in towards the center slightly, otherwise the switch lever will pass them and they will be of no use. For this reason it will be noted that the radius for these stops is given as

(*Continued on next page.*)

PANEL FOR REINARTZ TUNER WITH 2 STAGES OF AMPLIFICATION,



Another Good W-D-II Vacuum Tube Circuit

By F. D. PEARNE

THE simple W-D-11 vacuum tube circuit shown herewith is well adapted to fit the modest means of the amateur who desires to build an inexpensive set and still get good results. This outfit when used on an aerial of from 100 to 150 feet in length will bring in long distance stations very nicely.

Variometer Inductance.

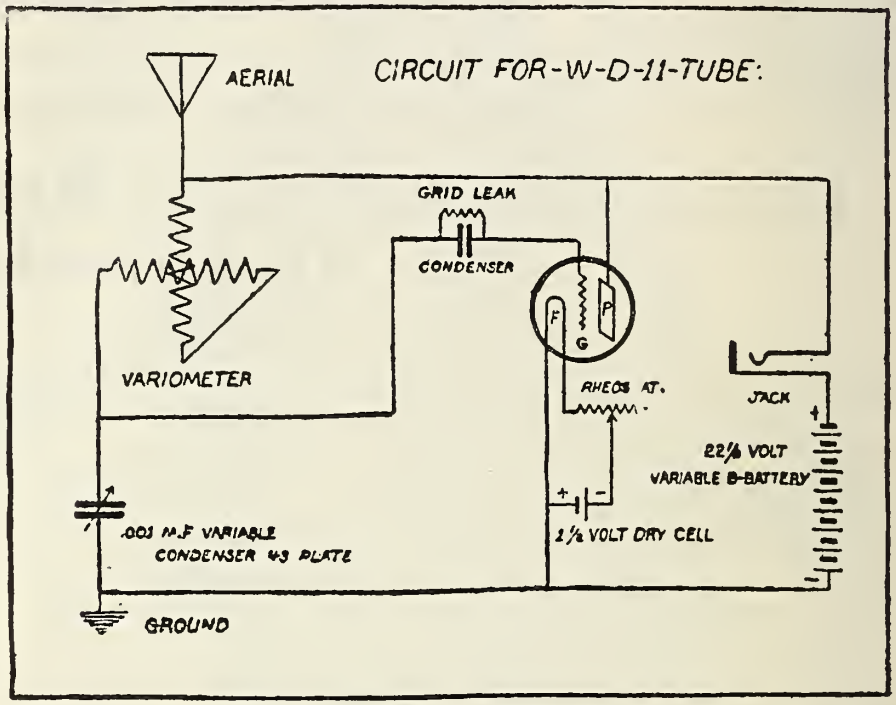
The inductance used in this case is obtained from an ordinary variometer which makes possible a very fine tuning from zero to the maximum capacity of the coils. The circuit is somewhat different from the other standard circuits, in that the variometer is connected between the plate and the grid. A 43 plate variable condenser is placed between the grid circuit and the ground. This combination arranged as shown in the drawing makes it possible to get very close tuning and is especially valuable in clearing up interference. The plate battery is the ordinary standard 22 1-2 volt battery which is usually found to be a little high for the proper working of the W-D-11 tube, so when purchasing this battery, be sure to get one which is tapped at different points, so that any voltage from 16 to 22 1-2 may be obtained as these tube characteristics vary considerably, and the pressure which is right for one tube is wrong for another.

It is very important that the plate voltage be just exactly right for the particular tube used. The grid leak and condenser shown in the drawing are the standard units used on most sets and can be found in any radio supply store, but if one wants to be a little more accurate, he can use a variable grid leak and variable condenser for this purpose. The variable condenser, however, is not so important as the variable grid leak.

The circuit shows a spring jack inserted between the "B" battery and the plate, so that a plug may be used for connecting and disconnecting the head phones. Many users of this circuit have used a filament control jack instead of the plain two way jack shown in the drawing. This is a very good thing to do as it is an assurance that the battery will not be left connected to the filament when the set is not in use.

Amplification.

The ordinary one or two step amplifier may be used in conjunction with this set, or by changing the sockets to fit W-D-11 tubes the amplifier, as well as the tuner, may be operated on 1 1-2 volts, thereby doing away with the storage battery, used on the ordinary amplifier. If W-D-11 tubes are used on the amplifier, one dry cell should be used for each tube inserted in the circuit. These cells should be connected in parallel, however, and not in series. This



means that all the carbon terminals of the three batteries should be connected together and all the zinc terminals together, using the group of three cells as one battery. In this manner the volume of the current is increased three times, while the voltage remains at 1 1-2. If the batteries are connected in series, the tubes will be instantly burned out, so great care should be used to see that the batteries are correctly connected.

Reinartz Tuner

(*Continued from page 3.*)

1 inch, which will bring them in far enough to make an efficient stop.

These contact points are to be spaced three-eighths of an inch apart, starting from the center one on each switch and spacing off with a lead pencil compass. Do not use dividers, as a slight slip will put an ugly mark on the polished surface of the panel, which cannot be erased.

The size of the holes given to accommodate the switch lever bearings is 5-16 of an inch. This is the size of most of them now on the market, but if one contemplates using some special make then the size should be changed accordingly. The two 5-16 inch holes shown below the switches are to be used for the shafts of the two condensers which are mounted directly behind them. The holes for the supporting screws of these condensers are not shown for the reason that they are not all alike and the builder will have to locate these himself, after he decides what make of condenser he is going to use.

The three countersunk holes at the bottom of the panel are to be used for fastening a baseboard to the back of the panel, to support the coil, sockets, transformers, etc. This base board should be just long enough to fit in the cabinet (if one is used), about 8 inches wide and 1-2 inch thick, and should be of hard wood if possible. This will form a convenient shelf for the mounting of all of those parts which are not mounted on the panel.

The three groups of five holes each are for the purpose of forming a window through which the brilliancy of the filaments may be observed. They should be slightly counter-sunk as shown, and the tubes should be mounted directly behind them, with the radio frequency, or detector tube, to the left, as the case may be.

The three holes below these windows are for the shafts of the rheostats. Here again the holes for mounting have been omitted for the reason that their location will depend upon the particular type of rheostat used. The three holes below the rheostats are to be used for jacks, if desired.

Adapting the Old Tuning Coil to the New W-D-11 Dry Cell Tubes

By F. D. PEARNE

THE new W-D-11 tube has caused many amateurs who have not been able to buy a storage battery to sit up and take notice. However, it is not always the lack of funds which prevent his having a tube set and battery, but very often the lack of proper facilities for charging it, when it runs down.

The fact that these new tubes will operate for several months on one cell of dry battery, has made them exceedingly popular, especially since they can be very nicely used in connection with some of the parts that were formerly used on the old crystal set. If one has either a one or two slide tuning coil on hand, it can be very easily adapted to this new circuit. This arrangement will give a much more efficient outfit at a very small additional cost. Because of the fact that this W-D-11 tube consumes only .2 amperes at 1.1 volts, it can be used on an average of one hour per day for about three months with one cell of ordinary dry battery.

These tubes have a different base than the Radiotron, or Cunningham type, hence the user will have to get the special socket which fits the tube. These, however, are not at all expensive.

In changing over the set to a tube set, the user will probably have an aerial already in use and a pair of head phones on hand and the additional apparatus required will be 1 W-D-11 tube and socket, 1 dry cell, 1 grid leak and condenser, 1 "B" battery having a voltage of 22 1-2, 1 rheostat, and 1 phone condenser. The rheostat is not absolutely necessary, but closer adjustments can be obtained if it is used. These parts should not cost more than $8, which is a very small cost for a good tube set.

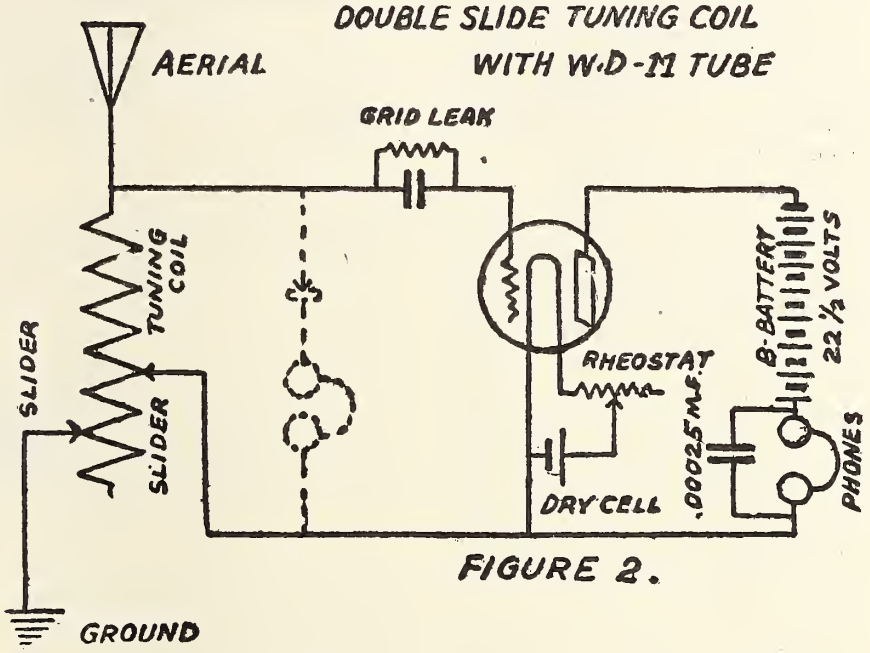


FIGURE 2.

The method of changing over a one slide tuning coil is shown in Figure 1. The crystal and phones shown in the dotted lines are to be omitted from the new set, when the new material is added. Connect one end of the coil to the aerial and grid leak with condenser and from there to the binding post, or connection on the socket marked "G." The post or connection marked "P" on the socket is next connected to the positive terminal of the "B" battery. The other terminal of the "B" battery is then connected to one side of the phones and the phone condenser. The other side of the phones and the condenser is connected to the positive terminal of the dry cell as shown. The carbon terminal of the dry cell is the positive side. How the dry cell is connected in the filament and rheostat circuit is plainly shown in the drawing.

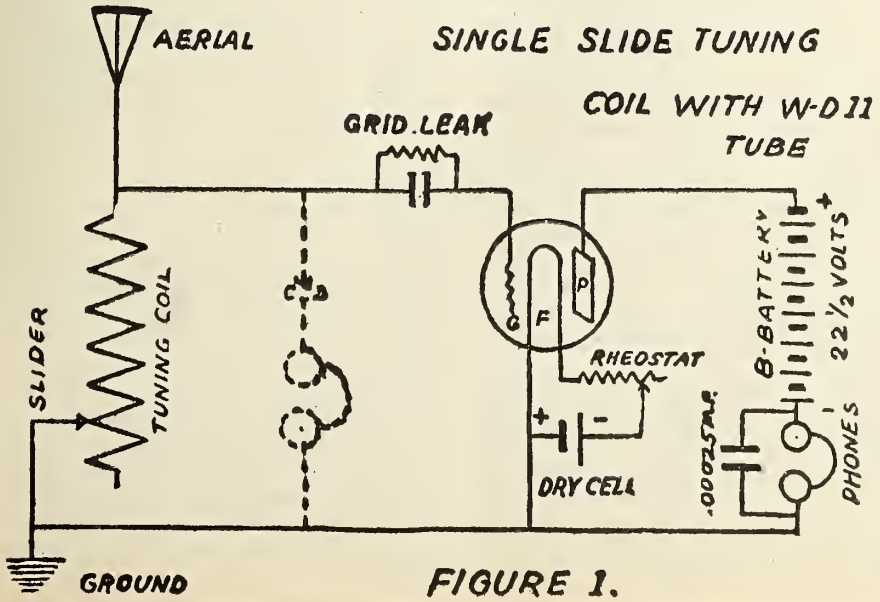


FIGURE 1.

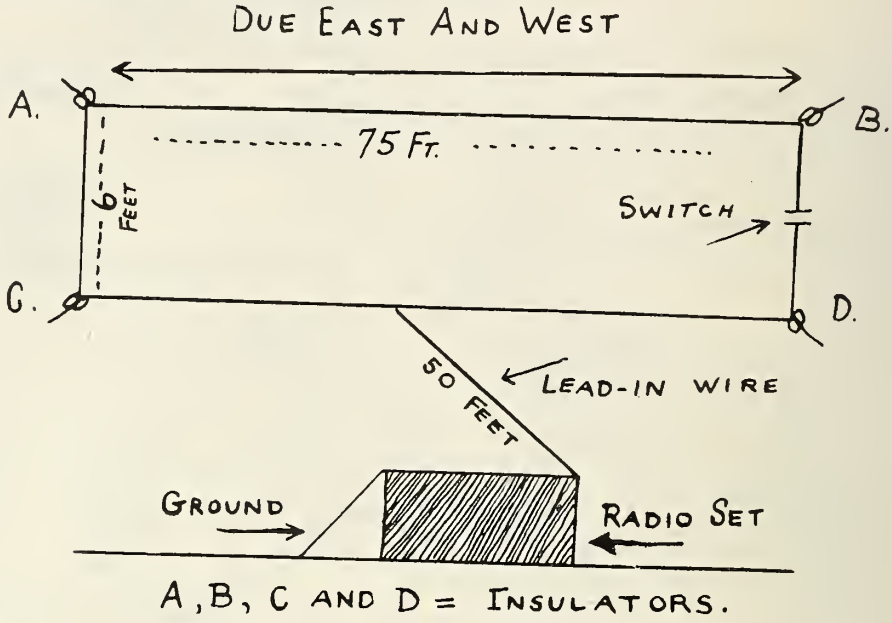
If the rheostat is omitted, then the negative terminal of the dry cell is connected directly to the filament, but some kind of a switch should be connected in the circuit so that the battery current may be shut off when the set is not in use. The positive terminal of the dry cell also goes to the ground and slider as shown. It is necessary that the "B" battery be of the "tapped" type, as the plate voltage will probably have to be varied, to obtain the best results, although the new and latest model of the W-D-11 tube work very well on 22 1-2 volts. Be sure that the "B" battery terminals are connected as shown, for a reversal of this order will give no results. The positive terminal must go to the plate contact on the socket.

The method of using a two slide tuner with this combination is shown in Figure 2. The only difference between this and the other circuit is that the wire which was connected to the slider and ground in the first instance is now connected to the second slider. The phone condenser used in both of these sets is the same, and is the standard .00025 phone condenser which is sold at all radio supply stores. It may be found that a condenser having a little more capacity may be used at this point, with better results. Either of these sets used in connection with a good pair of phones and a good aerial will give very good results.

How to Make the Crystal Set Do Long-Distance Work

AN INTERESTING sidelight on the importance of the aerial design in attempting to get long distance results out of the crystal set is supplied by Frank X. F. Howe, of 504 Oakland Ave., Milwaukee, Wis. Mr. Howe holds the Milwaukee record for distance reception with the crystal set and has acquired considerable fame therefrom.

For the thousands of fans who are interested in crystal sets and in making them bring in the far stations we reproduce a diagram showing the arrangement of the aerial which Mr. Howe uses.



Mr. Howe writes us that for six months he has been experimenting with the aerial and with different kinds of crystals. He says these are the two vital factors in good crystal set reception. He found only one bit of crystal in a gross of crystals that would do the work he wanted it to accomplish. In this Mr. Howe is in accord with Mr. George C. Haseltine, of Fort Stockton, Texas, who wrote in the last issue of this magazine that he had made his remarkable long distance records because he paid special attention to his aerial and lead-in and used none but high class phones and crystals.

Mr. Haseltine, who has one record of 1,147 miles with a crystal receiver, says the aerial and lead-in must be well insulated, with all connections soldered. He uses the Million Point crystal.

Mr. Howe's aerial is an inside loop. He says it enables him to increase the strength of the incoming signals to the value obtained with the average vacuum tube set with one stage of amplification.

He uses a tapped coil instead of a slide tuner. The aerial is strung in an attic, fifty feet from the ground and is stretched in an east and west direction. It is made of No. 14 bare copper wire and is arranged as a rectangular loop. The length of this rectangle is 75 feet and the ends are six feet long. It is suspended in such a manner that one long side of the loop is above the other, making the short ends perpendicular. It thus contains one hundred and sixty-two feet of wire.

The lead-in wire is attached to the aerial, Mr. Howe explains, careful measurement being made to insure its being attached to the exact center. On one end of the loop there is a switch which is thrown open when radio telegraph messages are being received. The lead-in wire is fifty feet in length and is the same size as the aerial wire.

Mr. Howe says the signals received with this hook-up are fifty per cent stronger than those received by any other arrangement he has seen or tested.

He also says that the same aerial, stretched north and south, was not satisfactory. This is a matter of experimenting as results might be different in different localities.

"This aerial arrangement was the result of an accident in some measure," says Mr. Howe. "I was experimenting with a vertically strung loop, open at one end, and I was changing the closed end of the loop to the other side of the loop. I got a reception, remarkably strong, before I could disconnect the perpendicular wire which I was trying to remove. I started to experiment, with the result described. I am sure the results obtained are due altogether to the style of the aerial as I have tested the crystal sets brought to me by friends and they have brought in the signals with great strength when attached to my aerial.

This hook-up enabled Mr. Howe to receive the program of Station WGL, of Philadelphia, about 1,000 miles distant. In getting this station, Mr. Howe used the aerial described, with vario-coupler, condenser and loading coil. (Description of how to make a loading coil at small cost is published in the January-February issue of Radio Age.)

Mr. Haseltine calls attention to the fact that in his long distance work he uses a "small loose-coupler," properly wound.

Long distance reception with crystal sets is without doubt becoming more general. Those who have succeeded best with these efficient crystal set hook-ups have different ideas of what is necessary to accomplish the result. All of which shows that there is more than one way of making the crystal set do its work.

Frank D. Pearne, technical editor of Radio Age, had a very interesting article in the January-February issue of this magazine in which he demonstrated that all crystal sets receive signals from long distances, but that in a majority of cases the sets were not capable of sufficiently fine tuning to make these signals audible. He showed in that article that finer tuning could be obtained with the addition of a series condenser, a vario-coupler, variometer and fixed shunt condenser. The article has received a great deal of favorable notice.

Send in your crystal set records for publication and tell us about any novelties in hook-up, etc. Also let us know what difficulties you want straightened out in your crystal set hook-ups. Send self-addressed and stamped envelope with your query.

"Wired Wireless" for the Millions

RADIO without antennae and without storage batteries! Recent experiments have shown that it is possible to get your radio entertainment and information by plugging in on the electric light socket. This idea of General Squier has been discussed for some time but practical application of the method seems likely to be made for the benefit of millions of radio fans.

We publish in this issue not only an account of how "wired wireless" is to be brought into the homes of radio fans, but we tell how the Bureau of Standards of the Department of Commerce instructs owners of tube sets in applying this marvelous new development in radio to their own set. In this connection the Bureau of Standards diagram appearing on another page will be found highly interesting.

WASHINGTON, D. C.—The demonstration of a new and unique method of communicating and broadcasting over electric light and power lines, by means of General Squier's system of "wired wireless, at the Bureau of Standards in Washington, indicates that within a short time all consumers of electric current may be able to plug in their radio sets to their lamp sockets and receive information and entertainment broadcast by the large light and power companies. The system is controlled by the North American Company of New York, which owns and operates the lighting utilities of Cleveland, Milwaukee, St. Louis and a number of other cities and which has secured an exclusive license under General Squier's patent rights for this purpose and is now developing the plan.

With the aid of a small condenser in series with vacuum tube receiving sets, or a special plug, consumers of electricity will be able to receive broadcasts from their electric wires just as they get "juice" to operate the flat iron, electric toaster or hair curler today. One button will produce "jazz," another news and a third grand opera, as soon as the power companies start broadcasting over their wire systems. The ether will in no way be disturbed by this sort of direct radio broadcasting, and Secretary Hoover will not have to assign wave lengths or worry about interference with other stations using the ether; there will be no interference as the air is not used.

With the aid of a regulation broadcasting set at a sub-station of the Potomac Electric Power Company, messages were transmitted, January 8, over this company's lines, carrying 2,400 volts of alternating current, to the signal corps laboratory, Bureau of Standards in Washington, where they were received by means of a tube set coupled with condensers. The sending station was located at Georgetown. The wave which followed the wires was of 5,000 meters or 30,000 cycles and a transmitting current of 0.050 amperes was employed.

Following tests of General Squier's invention in Cleveland last May and further trials in New York in August, the North American Company concluded that a practical application of the system was of value and would permit the furnishing of an additional important service to lighting and power customers. Since October, R. D. Duncan, Jr., chief radio engineer of the company, has been perfecting the methods.

At the public demonstration made January 8 Mr. Duncan made the following statement:

"In cooperation with the Potomac Electric Power Company, experiments have been under way for some time during which the voice has been transmitted over the high voltage lines of the latter company from the Georgetown and the Tennelytown sub-stations and received at the Bureau of Standards and at different points in Chevy Chase and Maryland. This system of communication, referred to in the past as "wired wireless," is the invention of Major-General George O. Squier, at present Chief Signal Officer, U. S. Army, and consists essentially of substituting for the transmitting and receiving antennas of radio stations, the electric light wire network of a city. Instead of the high frequency energy being radiated through space in all directions as with radio, it is confined and directed to flow along definite paths from the transmitting station to the various receivers. During the recent experiments the two sets of transmitting apparatus were connected through special circuits to the 2,400 volt three-phase distribution system. The receiving apparatus was plugged directly into the light socket as is done with an electric iron, toaster or other familiar appliance.

"The broadcasting was carried on simultaneously with the normal operation of the electric power system, there being no interference with either system by the other."

Voice Over High Tension Power Lines

BEFORE representatives of all the larger light and power companies of the United States, an amazing new use of radio was brought to light recently when it was demonstrated that voice conversations could be carried on by means of radio waves over high tension power lines, without the use of switches and just as are done in the ordinary telephone connection.

The test was carried out between experimental stations located in the Colfax and Brunots Island power stations of the Duquesne Light Company, points located about thirty miles apart, by engineers of the Westinghouse Electric & Manufacturing Company and the power company. It was also demonstrated that this system could be used for remote control of all manner of apparatus.

For a long period of time the Westinghouse Company has been working on a method of carrier current control for use in central power stations and electric railways, or other points using high tension electrical lines. The idea behind the whole scheme is to superimpose radio waves on the power lines and thus make use of radio transmitting and receiving for both voice communication and control of remote switches.

In this work the Duquesne Light Company has cooperated and pro-

vided experimental stations at its power stations in Brunots Island and Colfax, Pa.

Preliminary research work on ordinary transmission lines and feeder circuits had indicated that the use of wired wireless communication was simple and effective on such lines. But when trying out the Duquesne Light lines it was found that its system was complicated and extensive that many additional problems had had to be solved before it could be demonstrated that carrier current dispatching could be done successfully.

The members of the radio subcommittee of the National Electric Light Association, members of which are representative of all light and power companies of the United States decided to hold a meeting in Pittsburgh especially to see a demonstration of this revolutionary method of communication and control.

The test held Thursday afternoon, January 11, was entirely successful and demonstrated conclusively that this method interlacing the telephone with the power lines would soon be a feature in the plants of more progressive companies.

It was demonstrated in a small room of the power plant in Colfax, where the committee had assembled, that the carrier current system of telephony allowing communication over high tension lines besides saving an additional right of way does away with the great noises and high induced voltages which operates so much dread in talking along lines that parallel high tension systems.

The new system was demonstrated over a 66,000 volt line and is unique in that the system is duplex and operates as does the ordinary telephone. When the telephone receiver is unhooked, the transmitting station automatically starts up, allowing talk in both directions without any switching. This feature is entirely new in radio as all other transmitting and receiving must be done by switching back and forth, because a station transmitting will not receive messages. The transmitting apparatus must first be switched off and the receiving circuit switched in. However, all this is done away with in the newest of systems.

The calling or ringing of numbers is selective and operated by special selector keys which cause the bell to ring only at the station desired. This eliminates the distractive code ringing and allows station operators to keep their minds on their work.

The improved system developed by the Westinghouse Company has been carefully worked out by C. A. Boddie, radio engineer of the company and the technical and economic features are now being analysed by Mr. Boddie, assisted by M. W. Cooke, of the Duquesne Light Company.

The personnel of the committee witnessing the test was as follows: F. A. Allner, General Superintendent, Pennsylvania Water and Power Company, Baltimore, Md.; H. R. Searing, Superintendent Transportation, United Electric Light and Power Company, New York; L. W. Chubb, Manager of the Radio Engineering Department, of the Westinghouse Electric & Manufacturing Company; R. D. Duncan, formerly Chief Radio Engineer, U. S. Signal Corps, Washington, D. C.; E. P. Edwards, Manager, Radio Department, General Electric Company; G. A. Iler, Radio Expert, of Atlanta, Ga.; F. V. Magahaes, Superintendent, Testing Department, New York Edison Company; A. A. Meyer, Detroit Edison Company; and J. Morse, Shawington Water & Power Company of Montreal, Canada.

How to Adapt Your Set to New Use

THE Bureau of Standards of the Department of Commerce has developed in an experimental way a radio receiving set in which the usual batteries are eliminated, and connection is made instead to the ordinary electric lamp socket. The apparatus is an amplifier, which constitutes a receiving set when used with a simple tuner. It may be used with any type of antenna, i. e., with the ordinary elevated wire antenna, a coil antenna, or special forms of antenna.

The storage battery ordinarily required to light the filaments of the electron tubes is a drawback to the general use of radio sets. The battery must be charged from time to time; it is bulky and heavy, and the acid in it is a source of danger and damage in a household. In this amplifier both the filament storage battery and the dry battery used in the plate circuit are replaced by a special transformer and an electron-tube rectifier and accessories, the aggregate bulk and weight of which is less than that of the batteries.

It uses a small 10-volt dry battery in the grid circuit which is required to deliver only a very small current and should have a life practically equal to the life of the battery if not used at all, i. e., at least several months. In order to reduce the hum of the alternating current, there are more adjustments to make than in the ordinary amplifier supplied from batteries.

Of the parts which in this amplifier replace the storage battery in the ordinary amplifier, the special transformer is the only one the cost of which would approach the cost of a storage battery. The cost of the transformer would probably be mainly the labor of assembling.

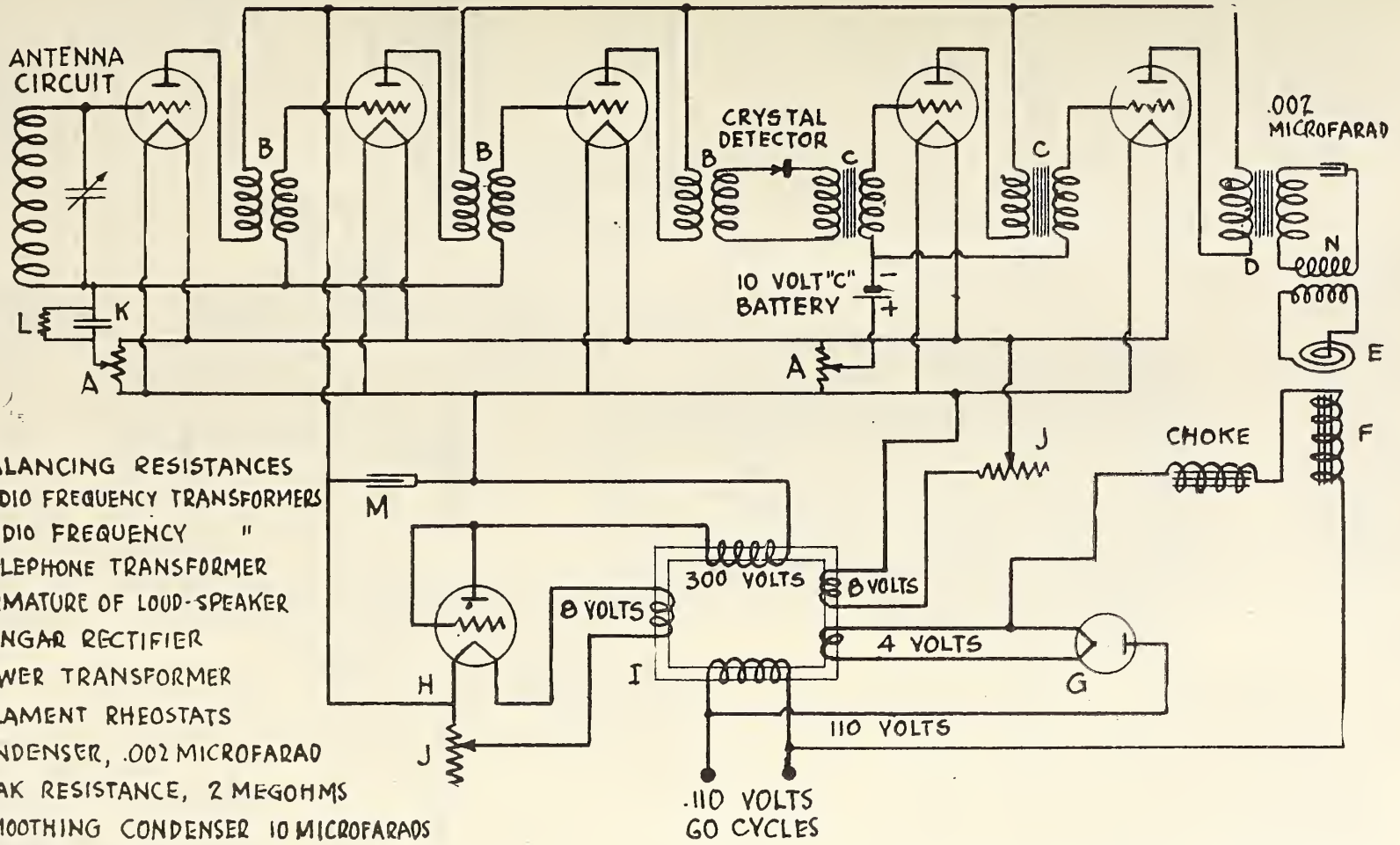
A statement was made in an early announcement of this amplifier that the storage battery is the most expensive part of the homemade radio receiving set. This may have been somewhat misleading, as the aggregate cost of the electron tubes in amplifiers, which employ several tubes, may exceed the cost of the battery. The cost of the battery, however, plus the cost of the usually necessary battery charging apparatus, generally exceeds any other item, even in an elaborate amplifier.

A few details of the amplifier, which utilizes 60-cycle current supply for both the filaments and plates of the electron tubes, are as follows: This amplifier has three radio-frequency stages and two audio-frequency stages, and uses a crystal detector. The 60-cycle current when used in an ordinary amplifier circuit introduces a strong 60-cycle note in the telephone receivers and makes reception impossible. This has been practically eliminated by the balancing resistances, grid condensers and special grid leaks of comparatively low resistance, telephone transformer in the output circuit, and use of crystal detector instead of electron tube detector. In the final form of the amplifier, there is only a slight residual hum which is not objectionable.

The amplification obtained with ac supply was as good as that obtained with the same amplifier used with dc supply. The complete outfit is compact and portable. The amplifier as constructed operated most satisfactorily for wave lengths from 200 to 750 meters. This range was determined by the working range of radio-frequency transformers used. By using suitable radio-frequency transformers, this range can be extended to receive any radio waves.

The circuit diagram of the outfit, including the means of supplying current to a loud-speaking telephone receiver, is given in the illustration on another page.

Amplifier Using Alternating Current



A-BALANCING RESISTANCES
B-RADIO FREQUENCY TRANSFORMERS
C-AUDIO FREQUENCY "
D-TELEPHONE TRANSFORMER
E-ARMATURE OF LOUD-SPEAKER
G-TUNGAR RECTIFIER
I-POWER TRANSFORMER
J-FILAMENT RHEOSTATS
K-CONDENSER, .002 MICROFARAD
L-LEAK RESISTANCE, 2 MEGOHMS
M-SMOOTHING CONDENSER 10 MICROFARADS
N-STEP DOWN TRANSFORMER FOR LOUD-SPEAKER
* H-PLATE VOLTAGE RECTIFIER

Five-stage amplifier, using crystal detector, and 60-cycle alternating current to supply power for the filaments and plate's

How to Make an Audio-Frequency Amplifier for Simple Set

(Bureau of Standards Circular 49)

1. Introduction.

MANY radio receiving sets include either a radio-frequency or an audio-frequency amplifier. A radio-frequency amplifier amplifies the radio-frequency signal before it is detected (rectified) by the crystal or electron tube detector, while an audio-frequency amplifier amplifies the rectified signal after it leaves the crystal or electron tube detector. The essential parts of either type of amplifier are the amplifier transformer and the electron tube.

This pamphlet describes an audio-frequency amplifier unit, that is, an amplifier employing a single electron tube. The detector may be either a crystal detector or an electron tube detector.

The amplifier unit is used by connecting it to the receiving set in place of the telephone receivers and then connecting the telephone receivers to the output of the amplifier.

The audio-frequency amplifier unit is aided to the tuner and detector so that the radio power received by the antenna may be transformed into sound in greater volume than would be possible by the use of a crystal or electron tube detector alone. The use of such an audio-frequency amplifier unit increases the receiving radius of the outfits described in previous pamphlets of the series approximately fifty per cent. Still greater receiving radius may be obtained by adding another amplifier unit just like the first one. It is usually not practical to use more than two stages of audio-frequency amplification—that is, two audio-frequency amplifier units.

One of these amplifier units added to a regenerative set increases the volume of sound in the telephone receivers.

Since a circuit including a crystal detector or simple electron tube detector will not make continuous-wave signals audible in the telephone receivers, the addition of an audio-frequency amplifier to these circuits will not accomplish this result.

The cost of this audi-frequency amplifier unit, complete with an electron tube, is between $13.00 and $21.00. This does not include the cost of batteries. If an electron tube detector is used in the receiving set, the same batteries are used for the amplifier unit. If, however, a storage battery for lighting the tube filament is not already available, this item will add from $15.00 to $22.00 to the estimate; and if dry batteries are not already available, the addition of two dry batteries for supplying voltage to the plate of the tube will add from $2.00 to $3.00 to this estimate. The cost of the tuner, crystal detector, telephone receivers and antenna equipment which are usually used with this amplifier is between $11.00 and $23.00. If the electron tube detector unit is used in place of the crystal detector, the cost of the complete equipment is increased by an amount varying between $7.00 and $13.70.

2. Essential Parts.

A complete radio receiving station comprises:

Antenna, lightning switch, ground connections and *telephone receivers.* These are described in Bureau of Standards Circular, No. 120.

Tuning Device.—This is either the tuning coil described in Bureau of Standards Circular No. 120, or the two-circuit coupler and variable condenser described in Bureau of Standards Circular, No. 121, or any commercial tuning device which covers the required wave-frequency range.

Detector.—This is either the crystal detector arranged as shown in Bureau of Standards Circulars, Nos. 120 and 121, the electron tube detector unit as described in Bureau of Standards L. C. 48 or Circular No. 133, or some satisfactory commercial electron tube detector unit.

Audio-frequency Amplifier Unit (Figs. 1 and 3).—The audio-frequency amplifier unit is composed of a baseboard *BB* and an upright panel *A*. On the baseboard *BB* is mounted an electron tube socket *SS*, an audio-frequency amplifier transformer *T*, and eight binding posts. On the upright panel *A* is mounted a filament rheostat *R* (the adjusting knob *J* is shown in Fig. 3) and two telephone receiver binding posts *L* and *M*.

Accessories.—Under the heading of accessories may be listed a six-volt storage battery ("A" battery) having an ampere-hour capacity of about 60, used for lighting the electron tube filament, a 45-volt dry battery ("B" battery) for supplying the electron tube plate voltage, binding posts, stiff copper wire (tinned wire is usually preferred) wood boards for the baseboard and upright panel, two brass angle braces for supporting the upright panel, miscellaneous wood screws, and suitable stain and varnish. A composition insulating material panel is sometimes substituted for the wood panel and the amplifier unit enclosed in a wood cabinet with a hinged cover. When the cabinet is added the eight base board binding posts are left exposed.

Baseboards (*BB*, Figs. 1 and 3).—The base *BB* is any kind of dry, well seasoned wood about 6 1-4 inches by 8 1-4 inches by 1-2 inch thick. Eight holes are drilled through the base in which the binding posts are fastened. The binding posts are spaced so that they present a neat appearance or according to the dimensions given in Fig. 3, Bureau of Standards L. C. 48 or Circular No. 133. The baseboard is arranged so that the three remaining sides and a hinged cover may be added without changing the positions of the binding posts. Under each of the four corners of the baseboard *BB* rubber or wood feet are fastened in order that the binding post heads and wiring on the under side of the baseboard will be protected.

Upright Panels (*A*. Figs. 1 and 3).—The panel *A* is any suitable dry, seasoned wood about 4 1-2 inches by 5 inches by 3-8 inch thick. In Fig. 1 a back view of the panel is shown which brings the two holes for the telephone receiver binding posts *L* and *M* in the lower left corner. (If the panel is viewed from the front these two holes will be at the lower right corner). This panel is made to present a good appearance, it being the front panel. Four holes are drilled in the panel *A*, one for the bolt which fastens the panel to the brace, (see *Z*, Fig. 1.) two for the telephone receiver binding posts *L* and *M* (Figs. 1 and 3) and one for the shaft of the filament rheostat *R* (See Fig. 1). The exact location and diameter of the hole for the rheostat shaft is determined from the rheostat itself. It is drilled so that the rheostat occupies as low a position as possible, allowing room enough to do the necessary wiring. Satisfactory upright panel measurements are given in Fig. 4 of Bureau of Standards L. C. 48 or Circular No. 133.

Electron Tube (*E*, Fig. 3).—The electron tube is a commercially available tube generally called an amplifier tube or "hard" tube. The several parts of an electron tube (sometimes called a vacuum tube) are described in "The Principles Underlying Radio Communication," Chapter 6.

Electron Tube Socket (*SS*. Figs. 1 and 3).—The electron tube socket is one of various commercially available types.

Audio-frequency Amplifier Transformer (*T*, Fig. 1).—The audio-frequency amplifier transformer is one of the various commercially available types.

Binding Posts.—The binding posts used on the baseboard are 6-32 or 8-32 brass machine screws each equipped with two nuts and two washers, if regular binding posts are not used. The telephone receiver binding posts, *L* and *M* (Figs. 1 and 3) are of the set-screw type to admit the tips of the telephone receiver cords.

Filament Rheostat (*R*, Fig. 1).—The filament rheostat is one of the various commercially available types designed for panel mounting and having a neat appearing knob and pointer. The rheostat has a resistance of about seven ohms and a current-carrying capacity of about 1 1-2 ampheres.

Accessories.—The accessory batteries are commercial articles. The purchaser of the six-volt storage battery ("A" battery) for lighting the filaments should get full instructions from the dealer for testing and recharging the battery. The 45 V "B" battery usually used for the plate circuit can not be recharged. The normal life of a dry battery of reliable manufacture is about six months.

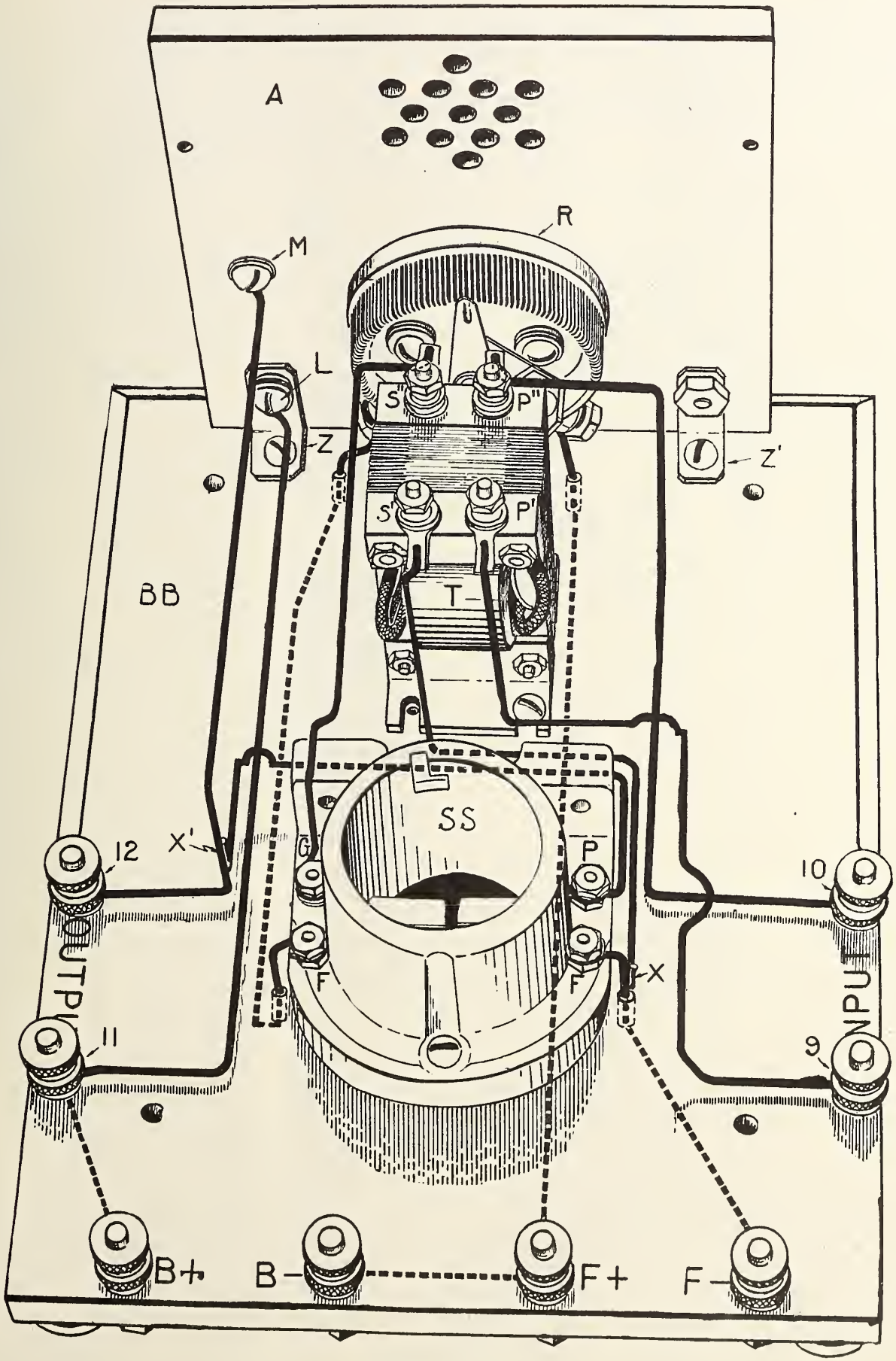


FIG. 1.

Storage batteries for use as "B" batteries are available. Their first cost is greater than that of dry batteries but they may be recharged.

Satisfactory dimensions for the brass angle braces are given in Fig. 1, Bureau of Standards L. C. 48 or Circular No. 133.

4. Assembly and Wiring.

Wood Finish.—It is essential that the wood be protected from moisture. The wood is first dried, and then finished with stain and varnish; a good grade of varnish, preferably insulating varnish, is used. Shellac or other alcohol dissolved resins are not used. This method of wood finishing is found more satisfactory than treating with paraffin as described in Bureau of Standards Circular No. 120. The exact method of drying and finishing wood depends upon the condition of the wood itself. The wood is usually placed in a warm oven for an hour or so to insure more or less complete drying. The use of lamp black or carbon pigment stains is avoided, and the stain and varnish is thoroughly dried before the apparatus is mounted on the wood baseboard and panel.

Baseboard (Fig. 1).—The eight brass machine screws or binding posts are put in the holes already drilled in the baseboard. If machine screws are used the heads are put on the under side of the baseboard with a brass washer between the head and the baseboard. A brass washer and two nuts are then fastened to each screw, on the upper side of the baseboard, with the washer next to the baseboard.

The tube socket, *SS*, and the transformer *T* are next screwed to the baseboard. The exact location of these parts varies according to the particular type used. One can get an idea of the relative position of the several parts from Fig. 2. The tube socket *SS* is mounted so that the two terminals marked *G* and *P* (Fig. 1) are nearest the upright panel. Wood blocks are put under the socket *SS*, when necessary, so that the four terminals of the socket do not touch the wood baseboard. This is done by cutting off two round wood blocks just long enough to raise the socket terminals clear of the base, and mounting them so that the screws which hold the socket to the baseboard will pass through holes in the centers of the blocks.

After the socket *SS*, and the transformer *T* are mounted, the parts are wired. Number 14 bare (preferably tinned) copper wire is used in wiring. This makes the connections stiff and self-supporting. This wire is ordinarily furnished in rolls and is straightened before being used. This is accomplished by clamping or otherwise fastening one end of the wire solidly and pulling on the other end just hard enough to stretch the wire slightly. All wires are run as directly as possible, consistent with good spacing and neat appearance, and all bends are made at right angles. When a wire is attached to a binding post, a loop or eye is formed on the end of the wire and the wire at the eye flattened with a hammer. This gives more contact surface. Special lugs are sometimes soldered to the ends of the wires before the connections are made.

A small hole is drilled through the baseboard near each of the tube socket terminals marked *F* (See Fig. 1). A short piece of wire is fastened to the right socket terminal marked *F* and is then led through the small hole in the baseboard to the under side of the baseboard. The same wire is led to the under side of the binding post marked *F* and fastened between the machine screw head and washer underneath the baseboard. All wires which are run on the underside of the baseboard, or are hidden by parts of the apparatus, are shown by dotted lines. A wire is soldered (at *X*) to the wire leading from the right socket terminal marked *F*, just above the baseboard, and led to the secondary terminal *S* of the transformer *T* and soldered or otherwise fastened thereto. This wire is shown as part solid and part dotted. The wires do not touch the wood boards except at the terminals and where the wires pass through holes in the baseboard. The wires may be raised more or less to accomplish this. Another wire is soldered to a primary terminal *P'*, of the transformer and led to the "input" binding post No. 9. Humps or bends are shown in this and other wires to indicate that the wires cross but do not touch.

A wire is soldered to the other primary terminal P" of the transformer *T* and goes from there to the other "input" binding post, No. 10. A similar wire reaches from the other secondary terminal S" of the transformer to the electron tube terminal marked *G*. The secondary transformer terminal, which connects to the terminal *G* of the electron tube socket, is that terminal which is internally connected to the outside of the secondary coil of the transformer. This is sometimes determined by inspection. In other cases it is necessary to try out the completed amplifier unit as described under "Operation." If good results are not obtained, the wire leading from *G* to *S"* is removed from *S"*, and connected to S', and the wire leading from *X* to *S"* is removed from *S'* and connected to *S"*.

A wire connects the binding post *B*+ and the "output" binding post, No. 11, on the underside of the baseboard. The remainder of the wiring is left until the upright panel is assembled and fastened to the baseboard.

Upright Panel (A. Fig. 1).—The filament rheostat *R* is mounted on the upright panel *A* so that the two terminals will be in a convenient position for wiring. Two binding posts of the set-screw, *L* and *M*, (Figs. 1 and 3) are inserted in their proper holes, and the upright panel mounted in position by bolting it to the two brass angle pieces (*Z* and *Z'*) shown in Fig. 1. One of the telephone receiver binding posts *L* serves as a bolt. Two small holes are drilled through the baseboard near the two terminals of the filament rheostat *R*. A wire is run from the "output" binding post No. 11 (Fig. 1) along the upper side of the baseboard to the back of the telephone receiver binding post marked *L*. A wire is fastened to the other "output" binding post (No. 12) and led to the rear of the upper telephone receiver binding post *M*. A wire is fastened to the electron tube socket terminal *P* and led to some convenient point *X'* on the wire leading from binding post No. 12 to *M*. The wires are soldered together at this point.

A wire is run from one of the filament rheostat binding posts through the hole in the baseboard and thence along the under side of the baseboard to the binding post marked *F*+ and is continued from *F*+, still underneath the baseboard, to the binding post marked *B*−. This wire is shown in Fig. 1 by a dotted line. Likewise a wire is run from the other rheostat binding post, underneath the baseboard and up through the left hole in the baseboard at the rear of the electron tube socket *SS* and connected to the left binding post marked *F*. This completes the assembling and wiring of the audio-frequency amplifier unit.

5. Connections.

If the two-circuit tuner and the electron tube detector are used with the audio-frequency amplifier unit, the several parts are arranged as shown in Fig. 3. Two amplifier units are shown making a two-stage amplifier. If only one unit is used the connections are correspondingly simple. If a "hard" or amplifier tube is used in the electron tube detector unit, the connection *V* from the "*B*" battery is not used, but instead the wire *V* is connected to the binding post *B*+ amplifier No. 1. Increasing the number of "B" batteries used to supply voltage to the plates of the amplifier tubes will usually increase the intensity or loudness of the amplifier radio signals, but at the same time the Quality of the tone will be impaired. The voltage should never be increased to as much as twice the rated plate voltage of the electron tube.

The two-circuit tuner and the tuning condenser *C* (shown at the left) are described in Bureau of Standards Circular No. 121. The location and wiring of the two additional binding posts, 5 and 6, on the baseboard supporting the tuning condenser *C*, are given in Fig. 6, Bureau of Standards L. C. 48 or Circular No. 133.

If the single circuit tuner and electron tube detector are used with the audio-frequency amplifier, the arrangement of the parts is also similar to that shown in Fig. 3 except that the single-circuit tuner (as described in Bureau of Standards Circular No. 120 and altered in Fig. 5, Bureau of Standards L. C. 48 or Circular No. 133) replaces the two-circuit receiving set. The binding posts, 5 and 6, on the single-circuit tuner are connected to the electron tube detector binding posts Nos. 1 and 2, respectively.

If the electron tube detector is not available, one method of connection is to use the audio-frequency amplifier with the single-circuit or the two-circuit radio receiving set shown in Bureau of Standards L. C. 48 or Circular No. 133. In this case the telephone receiver binding posts (+, Fig. 5, or *U*, Fig. 6, L. C. 48 or Circular No. 133) are connected directly to the amplifier "input" binding posts 9 and 10. The connections to the "A" and "B" batteries are the same as shown in Fig. 3 of this circular except that the wiring to the electron tube detector

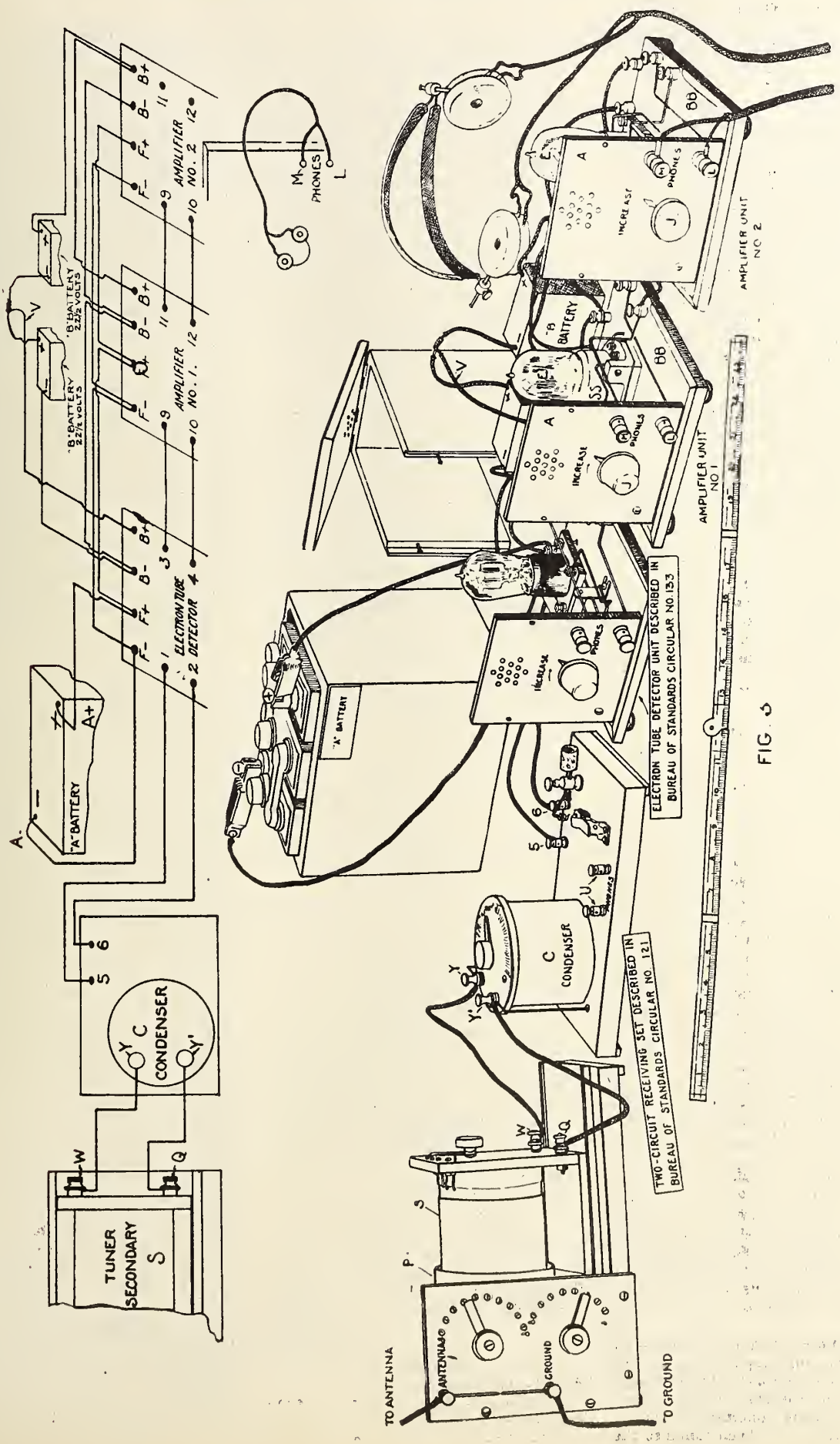

A-
"A" BATTERY
A+
"B" BATTERY 22½ VOLTS
V
F-
F+
B-
B+
1
2 DETECTOR
3
4 ELECTRON TUBE
9
10
11
12
AMPLIFIER NO. 1.
AMPLIFIER NO. 2
M PHONES L
TUNER SECONDARY S
5
6
C CONDENSER
Y
Y'
W
Q
P
TO ANTENNA
TO GROUND
ANTENNA
GROUND
"A" BATTERY
"B" BATTERY
INCREASE
PHONES
J
SS
BB
ELECTRON TUBE DETECTOR UNIT DESCRIBED IN BUREAU OF STANDARDS CIRCULAR NO. 133
TWO-CIRCUIT RECEIVING SET DESCRIBED IN BUREAU OF STANDARDS CIRCULAR NO. 121
AMPLIFIER UNIT NO 1
AMPLIFIER UNIT NO 2

FIG. 3

is omitted. Great care is taken to see that the "B" or plate battery is not connected to the binding posts marked $F+$ and $F-$. This battery has too high a voltage for the electron tube filament and will burn it out.

The antenna and ground wires are connected as described in Bureau of Standards Circular, No. 120, and as shown in Fig. 3.

To summarize, if the audio-frequency amplifier unit is used:

(1) with the two-circuit tuner and tuning condenser (circular No. 121) and electron tube detector (L. C. 48 or Circular No. 133), the connections are: W to Y, Q to Y^1, 5 to 1, 6 to 2, $A-$ to $F-$, $A+$ to $F+$, "B" battery— (black) to $B-$ to $B-$, "B" battery connection V to detector $B+$, "B" battery— (red) to amplifier $B+$. 3 to 9, 4 to 10, 11 to 9, 12 to 10, and the telephone receivers to L and M.

(2) with the single-circuit tuner (Circular No. 120) and electron tube detector, the connections are: 5 to 1, 6 to 2 and so on as given in (1).

(3) with the two-circuit receiving set when the crystal detector replaces the electron tube detector, the connections, are: W to Y, Q to Y', U (right) to 9, U (left) to 10, $A-$ to $F-$, $A+$ to $F+$. "B" battery— (black) to $B-$, no middle tap, "B" battery+ (red) to $B+$, and the telephone receivers to L and M.

(4) with the single-circuit receiving set when the crystal detector replaced the electron tube detector, the connections are: X (right) to 9, X (left) to 10, and so on as given in (3).

6. Operations.

The two filament rheostat knobs marked J (Fig. 3) on the two audio-frequency amplifier units, and also the filament rheostat knob on the electron tube detector unit, are turned to the extreme left or to the "off" position. Two electron tubes marked E ("hard" or amplifier tubes) are inserted in the sockets of the amplifier units (Nos. 1 and 2) and a third electron tube (preferably a "soft" or gas Tube) is inserted in the socket of the electron tube detector unit. The three filament rheostat knobs are then turned to the right until the filaments of the electron tubes become lighted, the brilliancy depending upon the type of electron tubes used. When one of the telephone receiver terminals is removed from its binding post (either L or M) and again touched to the post, a sharp "click" in the telephone receivers will be an approximate indication that the circuit is in working condition. If the test buzzer, as described in Bureau of Standards Circular, No. 120, is available it is attached by a flexible wire to the binding post W on the two-circuit tuner, or if the single-circuit tuner is used, the test buzzer is attached to the binding post marked "Ground," to determine when the detector is in working condition.

The test buzzer is not at all necessary when the receiving set employs an electron tube for a detector, as the "settings" of the filament rheostats largely determine the operating condition of the receiving set after it has been tuned to the proper wave frequency (wave length). When a crystal detector is used in place of the electron tube detector unit, a buzzer test is desirable to locate a sensitive point on the crystal.

When the crystal detector is not used the electron tube detector unit is merely substituted for it as shown in Fig. 3 and the tuning of the receiving circuit is the same as described in Bureau of Standards Circular No. 120 and 121. When the signals from a desired transmitting station are heard as loud as possible by tuning, the intensity is sometimes improved by adjusting one or more of the knobs on the filament rheostats so as to increase or decrease the filament current (current from the "A" battery). The knobs are kept in the positions of minimum filament currents without reducing the strength of the incoming signals.

7. Approximate Cost of Parts.

The following list gives the cost of parts of one Audi-frequency amplifier unit and the "A" and "B" batteries. It does not include the cost of the telephone receivers or any of the other equipment used to make up the outfits described in the previous pamphlets of the series. Some of the parts are the same as listed in the electron tube detector circular with some of the prices revised. If audio-frequency amplifier units are used, except that if a single "B" battery is used with the electron tube detector unit, one additional "B" battery is required.

Audio-Frequency Amplifier Unit.

Electron tube ("hard", -amplifier)	$ 6.50- $ 6.50
Electron tube socket	0.25 to 1.50
Filament rheostat	0.50 to 2.50
Audi-frequency amplifier transformer	5.00 to 8.00
Ten (10) feet No. 14 bare tinned cooper wire, about	0.10 0.10
Eight (8) binding posts, broad contact type	0.40 to 1.20
Two (2) binding posts, set-screw type (for telephone cord tips)	0.10 to 0.30
Miscellaneous wood screws, about	0.10- 0.10
Wood (hard, for base and panel)	
One (1) piece 8 1-4x 6 1-4x1-2 inches	
One (1) piece 5x4 1-2x 3-8 inches	
Four (4) rubber feet, about	0.10— 0.10
Wood (for cover)	
Two (2) pieces for sides 7 1-4x5x1-2 inches	
One (1) piece for back 5x3 3-4x1-2 inches	
One (1) piece for top 7 3-4x5 1-4x 1-2 inches	
Two (2) hinges for top, 3-4 inch	
Stain and varnish, solder, soldering flux	
	$13.05 to $20.30

Batteries.

"A" storage battery, 6-volt, 60-amperehour	$15.00 to $22.00
Two (2) "3" batteries 22 1-2 volts each	2.00 to 3.00
	17.00 to 25.00
Total	30.05 to 45.30

If the electron tube detector unit is equipped with a "soft" or "gas" tube, the voltage of the "B" battery is changed until the greatest signal intensity is obtained. This necessitates the use of a tapped "B" battery. This means that the wire V (Fig. 3), instead of connecting to the wire which connects the two "B" batteries, is provided with a clip which is connected to successive tapped terminals on one of the "B" batteries until the required voltage is obtained.

When two audio-frequency amplifier units are used a continuous "howl" is sometimes produced in the telephone receivers. In this case the wires leading to the "input" binding posts of one or both of the amplifier units are reversed, that is, binding post 3 is connected to binding post 10, and 4 to 9, and binding post 11 of amplifier No. 1 to binding post 10 of amplifier No. 2 and also 12 to 9.

In case the apparatus fails to operate the trouble may be attributed to a variety of causes. An inspection is first made of the various parts of the receiving equipment to determine if they are properly connected, special care being taken to see that the positive (+) and negative (−) terminals of the "A" battery are connected respectively to the binding posts marked $F+$ and $F-$, and that the positive (+, red) and negative (−, black) terminals of the "B" battery are connected respectively to the binding posts marked $B+$ and $B-$.

To determine if the various parts of the receiving circuit are in working condition the telephone receivers are removed from the "phone" binding posts on the amplifier unit and connected to the "phone" binding posts on the crystal detector receiving set. The wires connecting to binding posts 5 and 6 (Fig. 3) are temporarily removed and the fine coiled wire brought in contact with the crystal. The receiving set is then adjusted as described in Bureau of Standards Circular No. 120 or 121. This furnishes a means of ascertaining if the tuner is in working condition and also the crystal detector, although the latter is of course not used with the electron tube detector and amplifier units unless the electron tube detector unit is omitted.

The wires are now reconnected to the binding posts 5 and 6 and the telephone receivers are connected to the "phone" binding posts on the electron tube detector unit. One of the wires which is connected to one of the "output" binding posts of the electron tube detector unit is temporarily removed and tests made to determine if the electron tube detector is in working condition.

The telephone receivers are next connected to the "phone" binding posts on amplifier No. 1, the wire reconnected to the "output" binding post of the electron tube detector unit, and one of the wires disconnected from one of the "output" binding posts (11 or 12) of amplifier No. 1. Tests are then made to determine if amplifier No. 1 is in working condition.

The telephone receivers are then removed from amplifier No. 1 and attached

(*Continued on page 27.*)

Pick-Up Records by Our Readers

Irving Frisch, 923 East Thirty-first street, Brooklyn, writes:

Your September number fell into my hands and I must say that the occasions are few and far between when I have seen such an interesting magazine. You are to be congratulated on it. I built the Reinartz set described in that number and the first night I tried it on a single tube I received WHB, Kansas City; KYW, Chicago and PWX, Cuba. Since then I have heard WLAG, WCX, WGM, WSB, WOO, WIP, WFI, WGY, WDAC, KSD, WOC, KDKA and WJAX.

F. P. Foulk, 1114 Olney Street, Indianapolis, Ind., writes that he has received the following stations since Christmas: KSD, KYW, KDKA, PWX, WBX, WCX, WGY, WHB, WJH, WLK, WLW, WOC, WOH, WOR, WPA, WRW, WSB, WGM, WWJ, WAAF, WBAJ, WBAP, WCAE, WDAF, WEAF, WFAA, WHAS, WJAX, WKAN, WLAG, WMAQ, WMAX, CFCA, WIAO, WOO, WDAJ.

Mr. Foulk adds that his set consists of a WD 11, 1 1-2 V tube, a variable condenser and a home-made vario coupler. He uses no variometers or amplifiers. A truly fine showing.

Harold J. Brown, 223 W. Walnut street, Vicksburg, Mich., writes that he noticed in Radio Age the Reinartz records of Mr. Bisnak and Mr. Anderson. Mr. Brown also made a set and he reports having heard the following stations: WOC, WSB, WGM, WDAJ, WNAC, WHK, KOP, WWJ, KDKA, WGY, WJZ, WHB, WDAF, KYW, WFAA, WBAP, KSP, WGAF, WIAR, WGF, WCAE, WOI, WIAO, WGAM, CJCG, WMAQ, WOS, WBAJ, WLW, WIAF, WCX, WHAS, WHAM.

Mr. Brown says "I have a detector with no amplification and it sure does work well."

V. A. Mattingley, 2917½ East Thirty-fourth Street, Kansas City, Mo., writes:

"I see Mr. W. G. Lehr of Chicago has a good Reinartz set and I want to tell you about mine. I have a 43-23 and 3 plate condenser, three bulbs and thirty foot aerial. I hear California nearly every night and have heard KPO on one bulb. Here is a list of stations I heard in two nights: WBAD, WFAA, KPO, KFI, KFBF, PLPG, WHAZ, KSU, WDAP, WBAP, WAAK, KFCF, WOAZ, 9XU, CKCK, CFSE, KYW, WABJ, WOI, WGM, KHJ, WAAC, WDY, WGY, WKN.

"I have a vario-coupler and two variometers hook-up but that hook-up will not bring in anything like my Reinartz set. In tuning I have a wire from my ring on my little finger connected with the ground wire. It helps."

Lyle Penna, 1113 Maple avenue, Terre Haute, Ind., also challenges Mr. Anderson's record. Writing on January 10 Mr. Penna reports receiving sixty stations since December 16. He has received the principal stations in a score of states, including Minneapolis, Newark, San Antonio, Washington, D. C., Atlanta, Denver and three stations in New York state. Mr. Lyle uses a home-made set with a condenser, coupler, and detector with two stages of amplification. His aerial is twenty-five feet high, consists of two wires and is one hundred feet long. We congratulate Mr. Penna on having such a long string of scalps that we have not room to publish them all.

Hubert Kurtz, Chillicothe, Mo., writes:

"I read Mr. W. G. Lehr's "pick-up" record in the last issue of Radio Age. I thought I would let you know of the results I am having with my set. I completed my set about the middle of last month and, from January 1 to January 15, I picked up the following stations: WGY, WDAI, WHB, WDAF, WMAJ, WOQ, WOS, WLAG, WLAJ, WPA, WBAP, WOC, KDKA, WGM, WWJ, WRR, WHAB, WJAJ, WHAS, WLK, WLW, WAAP, WMAQ, WLAL, WQAQ, WJAT, WKAC, WCAR, WKY, KLZ, KSD.

My aerial is twenty-feet high and seventy-five feet long. I use one step of amplification and can hear all the stations very distinctly."

Russell Thomas, 4524 W. River Drive, Minneapolis, Minn., writes:

"In the February issue of Radio Age I noticed a letter signed by Mr. W. G. Lehr, who asked some person with a variometer-vario-coupler radio set to try to 'shoot' his record. I am leaving it to him if he doesn't think I have broken his record. Although I am using a variable condenser-vario-coupler set I think I am still qualified for the challenge. I am enclosing a diagram of my set. You will notice that the negatives of each group of 'B' batteries are paralleled and that this is connected to the negative rather than the positive of the 'A' battery.

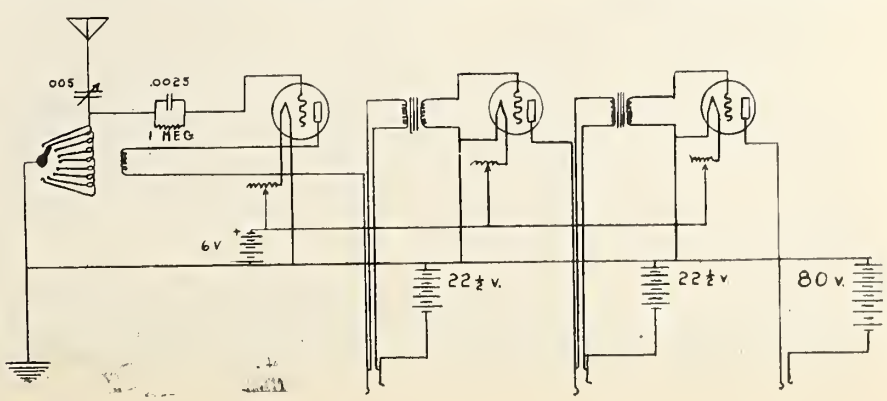
"On Friday, January 26, from 8:00 to 8:30 p. m. and from 10:00 p. m. to 1:00 a. m. I picked up the following stations: CFCA, WCX, WCAE, KYW, KSD, KDKA, WGY, CKCK, WBAP, WGM, WIP, WSB, WEAC, WJD, WLAL, KLZ, WPAC, WDAF, WJZ and WGV. On January 27 from 8:00 to 8:45 p. m. and from 11:00 p. m. to 1:00 a. m. I picked up stations: KOP, WSB, WOC, KYW, WCAE, WCM, KSD, WCAL, WFAA, WDAP, WDAF, CFCN, WJAX, KFI and CFCA. On December 10 at 7:45 p. m. I heard station WKAQ at San Juan, Porto Rico, and on December 16 between 4:00 and 6:00 p. m. I received stations: WMAT, WDAP, WHAS, KOP, WHK, WOS, WCAE, WJAT and WOR.

These results may be due to my aerial, which consists of two wires each two hundred feet long and fifty feet from the ground, running from northeast to southwest. I think my set has more to do with it than the aerial since I have heard KYW and a number of other stations using a light socket for an aerial and my regular aerial as a counterpoise ground."

Over 3,576 miles per hour is the distance covered by radio by Robert H. Anthony, 18 Cleveland Road, Needham, Mass. This speed was maintained December 30 and 31 over a period of six hours and twenty minutes. Among the cities visited (by radio) were San Francisco and Long Beach, Calif., Roswell, N. Mexico, Colorado Springs, Dallas and Fort Worth, Texas, and Havana, Cuba, not to mention such nearby communities as Milwaukee, Chicago, St. Louis, Atlanta, Birmingham, etc.

The broadcasting of all these cities and many more, totaling forty-five in all, was received during fourteen hours and twenty minutes operating time on the evenings of December 24, 25 and 30, and the early morning of December 31. The total number of miles covered during this time was 39,345, which establishes Mr. Anthony's claim to a Radio Golf of high rank.

Higher Radio Golf cards may have been turned in, but it is believed this is a record considering the time of play. "Radio Golf" is a new game invented by Frank Jones of Tuinucu, Cuba. It is a gentleman's game. Each one keeps his own score. A record is kept of the broadcasting stations heard. A broadcasting station can only be computed once. The mileage between the broad-



casting station and the radio receiving set is computed from the map and the various distances added up.

Mr. Anthony is New England Manager for R. Thomas Sons Co., manufacturers of electric porcelains. The equipment with which he made this phenomenal record was a receiver, employing one stage of radio frequency, and two stages of audio frequency amplification. San Francisco was heard clearly through a loud speaking horn.

Listed below is Mr. Anthony's score card:

December 24, Three Hours Play.

		Miles
WAAK	Milwaukee	920
WIP	Philadelphia	290
WOC	Davenport, Ia.	1,035
WGY	Schenectady	87
WRR	Dallas	1,610
WDAC	Springfield, Ill.	1,006
WHK	Cleveland	575
WHB	Kansas City, Mo.	1,294
WQAA	Parkersburg, Pa.	317
WJZ	Newark	201
WHD	Morgantown, W. Va.	544
WAH	Eldorado, Kansas	1,438
Local Stations		15
		9,332

December 25, Five Hours Play.

		Miles
WJZ	Newark	201
KYW	Chicago	892
WHD	Morgantown	544
WJAX	Cleveland	575
WGY	Schenectady	87
WWJ	Detroit	633
CFCF	Montreal	259
WBZ	Springfield, Mass.	66
KSD	St. Louis	1,092
WOO	Philadelphia	290
WYJ	Los Angeles	2,712
Local Stations		10
		7,361

December 30-31, Six Hours, Twenty Minutes Play.

		Miles
WEAF	New York City	201
WGM	Atlanta	978
WIP	Philadelphia	290
KDKA	Pittsburgh	489
WFI	Philadelphia	290
PWX	Havana	1,571
WAAK	Milwaukee	920
KSD	St. Louis	1,064
WRR	Dallas	1,610
WKM	Memphis	1,179
WPA	Ft. Worth, Texas	1,639
WDAC	Chicago	892
KHD	Colorado Springs	1,869
WMAF	So. Dartmouth	64
KNJ	Roswell, N. Mex.	1,984
KSS	Long Beach, Calif.	2,703
WSB	Atlanta	978
KDN	San Francisco	2,818
WSY	Birmingham, Ala.	1,093
Local Stations		20
		22,652

Grand Total—39,345 miles in 14 hours and 20 minutes.

W. M. K. Young, 414 New York Life Building, Kansas City, Mo., writes:

"I am using a Reinartz circuit and one stage of amplification, and want to tell you of its accomplishments.

"Last night I heard:

WCX	Detroit, Free Press
WWJ	Detroit, News
WHAS	Louisville, Ky., Courier Journal
WOS	Jefferson City, Mo., State Mkt. Bureau
WJAE	San Antonio, Texas, Texas Radio Corp.
KSD	St. Louis, Mo., Post Despatch
KJR	Seattle, Wash., N. W. Rad. Service Corp.

"All of these stations were heard without having any ground wire connected to my set, using a hundred foot aerial and I did this while WDAF, The Kansas City Star, was broadcasting their regular program and they are only twenty city blocks from me. If there is anyone who can beat this, we will be glad to hear from them.

"I have repeatedly heard the following stations and am giving air line mileage obtained by measuring from Kansas City to the station named on the map with ruler:

		Miles
KJR	Seattle, Wash.	1,582
PWX	Havana, Cuba	1,769
KDN	San Francisco	1,433
KHJ	Los Angeles	1,305
WCN	Worcester, Mass.	1,172
WGY	Schenectady, N. Y.	1,065
WRL	Schenectady, N. Y.	1,065
KFDD	Hanford, Calif.	1,278
WOR	Newark, N. J.	1,050
1XAE	Springfield, Mass.	1,136
CFCN	Calgary, Can.	1,225
CJCG	Winnipeg, Can.	746
CFCA	Toronto, Can.	855
WGM	Atlanta, Ga.	650
WSB	Atlanta, Ga.	650
WCX	Detroit	635
WWJ	Detroit	635
WMAK	Lockport, N. Y.	852
KDKA	Pittsburgh, Pa.	746
WHAS	Louisville, Ky.	480
WLW	Cincinnati, Ohio	527
KLZ	Denver, Colo.	560
DN4	Denver, Colo.	560
KFAF	Denver, Colo.	560
WJAE	San Antonio, Texas	705
WOAI	San Antonio, Texas	705
WCAE	Pittsburgh, Pa.	746
WDAJ	Collegeport, Ga.	652
WRR	Dallas, Texas	416
WLAG	Minneapolis, Minn.	416
WFAA	Dallas, Texas	416
KYW	Chicago, Ill.	400
WDAP	Chicago, Ill.	400
WLK	Indianapolis, Ind.	453
WBAP	Ft. Worth, Texas	456
WPA	Ft. Worth, Texas	456
		28,757

"These stations come in clearly and I heard complete programs from nearly every one of them. I have also heard CFCB Vancouver, B. C., 1,710 miles, and WLAY, Fairbanks, Alaska, 3,160 miles, but only once.

"I do not believe that the above distances covered can be improved upon very much when only using one stage of amplification. Please consider these distances in your record contest. Total, including Vancouver and Alaska, 33,627 miles."

Trevor Lakin, Anderson, Ind., writes: "I noticed in your last issue that W. G. Lehr, of Chicago, reported some records. I am not a knocker but I wish to tell of a small record I made recently. I shall not take time and space for all of them. Here are a few: WMAV, KFI, KWH, KHJ, KPO, KGU and KDYX (Honolulu) KFAJ, KLZ, KFAF, KOA, PWX (Havana) CFCN (Calgary, Can.) CKCK (Regina, Saskatchewan, Can,) CHYC and CFCF (Montreal, Can.) KOB (State College, N. M.) KNJ, WCAK, WEAF, WEAY, WCAR, WOAI, CJGG (Winnipeg) WHAB, WDAL, WJAR. I have one-tube Reinartz set. It is constructed altogether differently from any hook-up I have ever seen. In fact, it is original. I have heard 204 stations, not counting CW or spark. My aerial is a cage type, about 25 feet high at one end and thirty at the other."

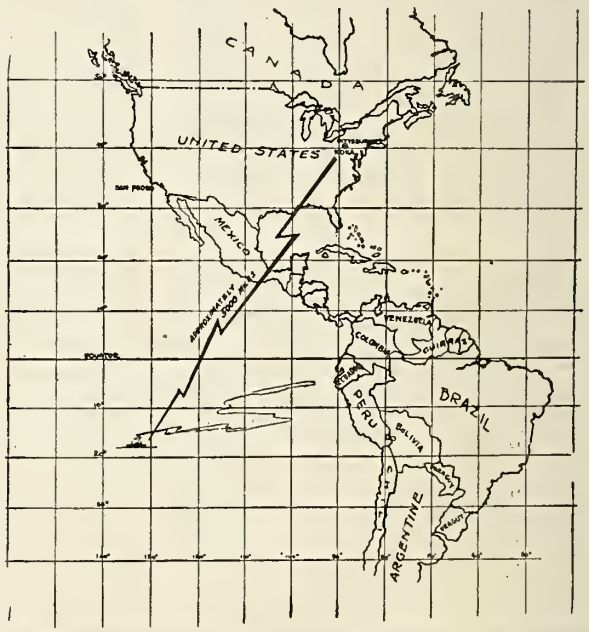
Mr. Lakin will be talking to Australia next.

Drew MacDougal and Teddy MacDougal, of Nichols, Iowa, write: "We have subscribed to Radio Age and think it is a fine magazine. We are specially interested in your pickup records. Our set is a non-regenerative, single circuit set with a homemade loose coupler and no amplification. Here are some of the stations we get regularly: WGY, WBZ, KDKA, CFCA, CJCA, WLAL, WEAF, WJZ. Here are some we have received several times: WMAF, KWH, KFQ, WAAC, KFDF, CFCN, CKCK, WFAH, WGI, WOR, WFI. Of course we get Chicago, Atlanta, Omaha, Denver, Dallas, Fort Worth, Indianapolis, etc., all the time. We get KHJ at Los Angeles every night. We have received 115 stations in twenty-seven states and four provinces in Canada. We have also heard Denver with a crystal set and nine other stations. We would like to see some of these records in your magazine if they are good enough."

We say they are good enough.

KDKA Breaks Record

Broadcasting a concert 5,000 miles is the proud record of KDKA, the radiophone broadcasting station of the West-

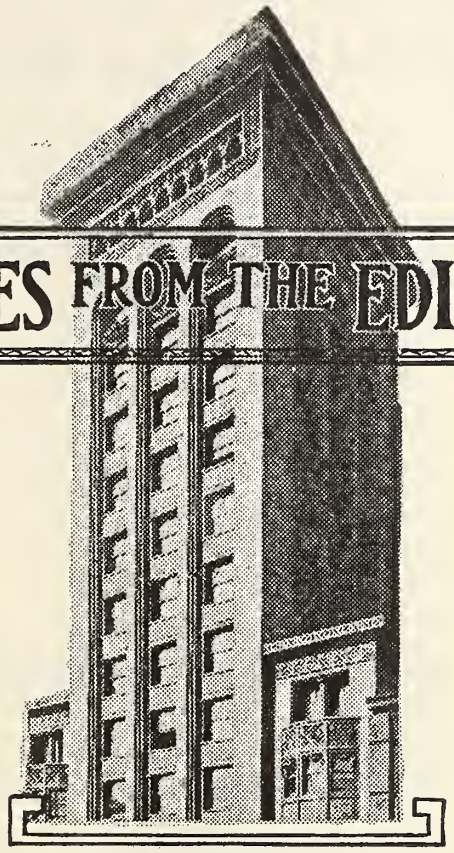


Map shows the distance the radio waves traveled in carrying KDKA's concert to a ship off the coast of Peru.

inghouse Electric & Manufacturing Company, located at East Pittsburgh, Pa., which is the real pioneer broadcasting station in the country.

This latest achievement of KDKA, which first started operating November 2, 1920, and which, by its continuous operating, started the world off on the radiophone craze, was brought to the attention of the Westinghouse broadcasting officials upon the receipt of a postal card from E. G. Osterhouldt, radio operator of the SS. "J. A. Moffett" in which he tells of hearing KDKA while off the coast of Peru, a distance of approximately 5,000 miles.

Send $1.00 to Radio Age, 64 Randolph Street, Chicago, and receive this middle-west radio periodical for six months. Regular subscription price is $2.50 per year.



THOUGHT WAVES FROM THE EDITORIAL TOWER

YE EDITOR was listening in the other night when transmission conditions seemed ideal. Slight turns of the rheostats brought pleasing proof that stations all the way to the Atlantic coast were trying to greet him, chat with him, play music for him, sing for him.

Alas! There was a high official of our government in town who was scheduled for a speech to a convention of business men. Ye editor did not want to hear a long talk about business and government. It is a dry subject at best and it requires the genius of an orator to make it passably entertaining. Anyhow, ye editor had plenty of newspapers and magazines at hand wherein he could find such topics ably discussed if he cared for them.

That high government official talked and talked. The newspapers the next morning boiled his speech down to a few paragraphs and they would not have given him more than a stickful if he had not been a high government official.

It seemed to ye editor that the broadcasting station that transmitted the speech could learn something from the newspapers. A speech that is too dull to print certainly has no place on the air for a two-hour period.

While we are grouching about this, let us say three words about soprano solos, long sermons, and extremely classical piano renditions. Make 'em snappy.

Evening is the time for wholesome recreation. Those hours between dinner and bedtime are the precious radio hours. They should be filled with variety, vivacity.

Of course we know that the instructions are to tune out the undesirable and tune in something else. For the thousands who depend upon crystal sets this is a funereal jest. For the many other thousands who have invested in tube receiving sets incapable of tuning out a 400 meter station almost within sight of their aerials it also is a bit of irritating advice.

Ye editor does not wish to be misunderstood. He likes a good sermon in season, is charmed by good singing and nothing pleases him more than a speech by a man whose logic gets all ablaze and makes him eloquent.

But there is a great difference between speeches, sermons and songs. A speech is not necessarily broadcastable simply because it is a speech and the speaker has been elected to something. A song, poorly sung, is as painful as a soft corn and a long sermon proves that the clergyman is not visibly impressed with the example of the Nazarene, who was the greatest Preacher of them all.

In short, broadcasters should be careful to give the fans what the fans want and not what the broadcaster thinks the fans ought to want. And it is a man's job to do the one and avoid the other. Station WDAP has the thing pretty well reasoned out.

Ye editor, however, has no brief for a western friend, who listened in on a particularly highbrow program of Bach and Browning and business until he lost patience, disconnected his A battery and shouted into the throat of the loud speaker one ungentlemanly word, "Beaver!" Now what did he mean by that?

UNDER the terms of the White Radio Bill, recently passed by the House, the Secretary of Commerce is authorized to refuse to grant licenses to those applicants who seem to be monopolizing or seeking to monopolize radio service. We hope the Senate will not modify this provision and that Secretary Hoover will never hesitate to use this explicit authority. If any of the big companies enjoying monopolies in their various communities in dispensing of electrical service, ever make a definite effort to gobble up the sport of millions there will be a popular howl that will need no amplification to make it audible.

Radio justly belongs to the people. Let it stay in the hands of the people To those who are weary of our warnings against radio monopoly we say only that we have been sounding such warnings for a year and we have only started.

IT IS with the greatest pleasure that we call attention to the sportsmanlike attitude adopted by amateur radio transmitters as represented particularly by the Relay League. The amateurs have recognized that their messages threatened to interfere with satisfactory reception of broadcasting programs and they have bowed to the wishes of several millions of fans and arranged their own transmitting conditions in such a way as to minimize interference. These amateur radio telegraphers were the pioneers in American wireless and their surrendering of their former freedom in their beloved avocation involves a sacrifice that every radio fan should recognize and gratefully acknowledge.

Secretary Hoover says he doesn't care who controls radio, and is willing to turn it over to the Interstate Commerce Commission if Congress so decides, but he does insist that some regulations be enacted into law and that some one be put in charge to relieve the interference, handle licenses, and assign the waves.

The Director of Radio, or whatever his title may be, will have his hands full controlling the waves, it is pointed out by one fiend on history, who recalls that Old King Canute got into difficulties some years ago and wet his feet terribly trying to do the same thing.

Despite the general use of radio and the millions of fans informed as to the reception of broadcasts, some remain ignorant of possibilities. The other day, in the National Press Club, one member suggested that the set be "speeded up," saying the music coming in was "too slow."

Radio Bill Held Up By Senate

(Special to Radio Age)

As this issue goes to press it appears unlikely that the Kellogg-White Radio Bill, which was passed by the House recently, will be passed by the Senate this session. If the Senate does not act in this session, it means that rdio must wait at least until next December for relief by legislation.

WASHINGTON, D. C.—With the passage of the White bill by the House of Representatives, broad powers have been vested in the Secretary of Commerce in regulation and supervision of radio broadcasting. Radio owners are jubilant because at last there is to be a new allocation of wave lengths, which, it is hoped, will eliminate overlapping of programs and interference with good reception. The bill is now in the Senate, where its progress will be followed with keen interest.

The Secretary of Commerce not only will have control of the wave lengths designated to each station but he will have the power to regulate the periods occupied by the programs of each station.

Licenses will be required from all transmitting operators excepting government employes. Army and Navy and other government stations, although exempt from the license provision, will be required to conform with the rules when handling commercial or other non-government business.

Assigning of wave lengths for the government stations will be in the hands of the President. The bill provides for an Advisory Committee consisting of men appointed by various department heads, radio experts and amateurs, to keep abreast of developments and needs of the radio industry.

Amateur receiving stations will not come under the regulatory provisions of the bill and amateur sending stations will have a special series of wave lengths assigned to them.

One encouraging provision in the bill is the explicit declaration against monopoly and the steps it outlines for preventing any of the super-corporations from seizing control of the industry. Under this law the Secretary of Commerce is directed to refuse licenses to any applicant, if it appears that the granting of those licenses would tend to assist a monopoly.

Representations were made to the House Committee on Merchant Marine, which had the bill in charge, that monopoly of radio service might be obtained by the Radio Corporation of America, headed by General Harbord and backed by the General Electric Company and by the J. P. Morgan interests.

The Radio Corporation, it was represented, might control the air through obtaining patents on devices and exclusive rights to certain bands of wave lengths. Thus, it was pointed out, the corporation might actually control all radio service for a foreign nation to the United States.

Even if the Secretary of Commerce should grant a license to an applicant "monopolizing or seeking to monopolize radio communication" the United States would not be estopped from prosecuting a licensee for "violation of the law against monopolies or restraint of trade."

One misunderstanding arose as to the interpretation of the section of the bill relating to the licensing by the Department of Commerce of all operators who handle commercial traffic. Many of the Naval ship and shore stations and some of the Army's transports and stations in Alaska now transmit commercial messages in public interest, when there are no other means of forwarding them by radio or wire. A strict interpretation of the bill would require that Army or Naval operators who handled such messages be licensed by the Department of Commerce, and Secretary Hoover stated at the hearing that the Navy should not have privileges denied other users of wireless. He agreed, however, that he and Secretary Denby would confer on the matter.

White Seeks to Placate Hoover and Denby.

As a result of an executive session, Chairman White waited upon Secretary Denby and Secretary Hoover Saturday with a plan of compromise on the licensing of naval and military operators and the control of Army and Navy stations. An agreement between the Department heads was accomplished.

Both Army and Naval officials point out the fact that if their operators were forced to take the commercial examinations, it would handicap their work, necessitate considerable travel and split authority over them. It would also complicate grades in the services, as today the Navy has several classes of operators, the Army only two, while there are three grades of commercial licenses. On the other hand, the Department of Commerce has not the funds or personnel to examine all the operators of the two military services, many of whom are scattered all over the world; they want only a compliance with regulations and fair competition in commercial work. Signal Corps officials would regret the necessity of having to handle commercial work, explaining that they do so only when no other means of communication is available. This is the case in the Navy, too; the Department is most anxious to get rid of its commercial work, although it is glad to aid in transmitting messages from out-of-the-way places. Recently eight Navy stations were closed, but on request two were re-opened. If Navy men had to be licensed as commercial operators, Secretary Denby said he would refuse all future commercial traffic.

Commenting on the situation, Secretary Hoover said that the point of disagreement with the Navy was not a wide one, and he was willing to compromise in the interest of the public. The bill, he explained, was intended to control only those radio transmitting stations carrying on a regular commercial or broadcasting service, and to license their operators.

The bill, which was passed by the house on Wednesday last, has been transmitted to the Senate, where it awaits assignment to a committee.

When the bill is assigned, early action is still hoped for, although some Senators admit that if it is likely to incur much debate and obstacles are thrown in its way, it will be impossible to pass it this session.

Secretary Hoover, after a conference with Senator Kellogg, was sanguine as to the bill's passage in the Senate this session, unless some obstructionists interfere.

Based upon the present number of stations and operators and at rates now set forth in the bill, the Department expects to collect annually a sum approximating $186,000 in fees for licenses. Amateurs will pay a considerable portion of this. This would offset a large part of the expenses of administering, inspecting and licensing the stations and individuals. This money would not be received in cash by the radio section of the Department but would be collected through the sale of Government revenue stamps and would constitute additional income to the Government. Thus, it is explained radio interests and individuals would actually be paying for supervision and service, which would require almost double the work.

The bill does not carry any salaries for the members of the Advisory Committee, who are not Governmental employes, but provides for the payment of their expenses when in session in Washington. One of Secretary Hoover's first acts, it is understood, following the passage of radio legislation, would be to secure the appointment of this committee and call a session for the immediate revision of the wave assignment schedule.

The Monthly Service Bulletin of the

NATIONAL BROADCASTERS' LEAGUE

Solely by, of and for Radio Broadcasting Station Owners

George S. Walker
Western Radio Corporation
Denver, Col.
President

Arthur E. Ford, E. E.
State University of Iowa
First Vice President

W. J. Baldwin, W S Y
Alabama Power Co.
Birmingham, Ala.
Second Vice President

Frederick A. Smith
Garrick Building,
Chicago
Secretary

Founded to promote the best interest of Radio Broadcasting stations in the United States and Canada.

Executive Offices, Garrick Building, Chicago, Ill.

DIRECTORS:

T. B. Hatfield, W O H
President Hatfield Electric Co.
Indianapolis, Ind.

S. W. Place, W B A G
Radio Engineer,
Diamond State Fibre Co.
Bridgeport, Pa.

T. W. Findley, W L A G
President and Genl. Mgr
Findley Electric Co.
Minneapolis, Minn.

Stanley O. Need, W G A H
The New Haven Electric Co.
New Haven, Conn.

Earle C. Anthony, K F I
Earle C. Anthony, Inc.
Los Angeles, Cal.

Howard E. Campbell, W W J
The Detroit News,
Detroit, Mich.

A. J. Westland, W W L
Physics Dept. Loyola University
New Orleans, La.

J. Elliott Jenkins, W D A P
Midwest Radio Central, Inc.
Drake Hotel, Chicago, Ill.

H. A. Trask, K S D
St. Louis Post Dispatch
St. Louis, Mo.

Frank W. Elliott, W O C
Palmer School of Chiropractic
Davenport, Ia.

SIXTEEN broadcasting stations have joined the National Broadcasters' League since the last list published. It is noticeable that all the stations coming into the organization are of the progressive class. Their letters indicate that they are keenly interested in the continued high character of broadcasting and ever watchful lest any action be taken which would tend to interfere with the truly important service the transmitting stations are performing for the radio millions.

The list of new members follows:

WCAJ, University Place, Nebraska, Nebraska Wesleyan University.

KSD, St. Louis, Mo., The St. Louis Post Dispatch

WSY, Birmingham, Ala., Alabama Power Co.

WCAU, Philadelphia, Pa., Durham & Co., 1936 Market Street.

WLAQ, Kalamazoo, Mich., A. E. Schilling.

WHAH, Joplin, Mo., Hafer Supply Co., John T. Griffin.

W2AA, Parkersburgh, Pa., Horace A. Beale, Jr.

WLK, Indianapolis, Ind., Hamilton Manufacturing Co., 2011 North Alabama Street.

WOAA, Ardmore, Oklahoma; Dr. Walter Hardy.

WAAZ, Emporia, Kans., Hollister-Miller Motor Co.

WFAB, Syracuse, N. Y., C. F. Woese.

WHAD, Marquette University, Milwaukee, Wis.

WNAC, Boston, Mass., Shepard Stores.

WMAQ, Chicago, Ill., The Chicago Daily News, 15 North Wells St.

KGB, Tacoma, Wash., Tacoma Daily Ledger, H. F. Higgins.

KFAF, Denver, Col. Western Radio Corporation, George S. Walker, 1627 Champa Street.

The secretary suggests that all members of the League write to the secretary, Frederick Smith, Garrick Building, Chicago, outlining their views on the allocation of wave-lengths, the question of fees for copyrighted music, etc., the difficulty in obtaining needed equipment on the open market and expressing their wishes in connection with any other matters that will come to the attention of the Secretary of Commerce at Washington under the new radio bill which has just been passed by the House at Washington.

Now is the time to act in concert. It is certain that Mr. Hoover will not fail to pay attention to communications from an organization of broadcasters representing big stations in most of the states of the union. Send along your letters and they will be transmitted to Secretary Hoover in a manner that will impress him with our earnestness of purpose and with our desire to cooperate in the difficult task that is being assigned to him.

The recent conference on standardization, held in New York under the call of the Bureau of Standards, Department of Commerce, took no definite action regarding the standardization of "service," which means broadcasting. The details of this standardization of broadcasting will necessarily command the attention and the vital interest of every man in the broadcasting field.

Members should write to the secretary, giving their views on broadcasting, its difficulties and its needs. This correspondence will be sent forward to the committee of radio engineering institutes which have practically the disposal of these questions, in cooperation with the Secretary of Commerce and with the radio manufacturers, dealers, amateurs, radio-owners, commercial transmitters, broadcasters of entertainment, etc.

Such correspondence presented *collectively* will convince the committee chiefs and the officials at Washington that the National Broadcasters' League is an aggressive, live organization that knows what it wants and wants nothing but the good of radio and radio service.

Send on your letters. Don't wait for the other fellow to make suggestions. Each individual opinion is needed and now is the time to make our wishes known. We have an important organization. Let's go.

The following appears in the Radio Service Bulletin of January 2, 1923, issued by the Bureau of Navigation of the Department of Commerce:

"Broadcasting Stations Violating Section 2 of the Act of August 13, 1912.

"Operators of broadcasting stations are cautioned not to communicate with other stations. The transmission of acknowledgments to individuals relating to the receipt of letters, telegrams, and telephone calls is direct communication and not authorized in the licenses of broadcasting stations. Section 2 of the Act of August 13, 1912, states that the license of a station "shall state the purpose of the station," and as broadcasting stations are licensed for the specified service of broadcasting, any operator using a broadcasting station for point-to-point communication may have his license suspended or revoked in the discretion of the Secretary of Commerce. Owners of broadcasting stations should see that the above-cited act is not violated as the use of their stations for purposes other than specified in the station license is sufficient cause for the suspension or revocation of their station license."

For the first time since broadcasting began in September, 1921, fewer new stations were licensed during January than dropped out, indicating that the field for broadcasting is practically filled. This is not to be wondered at, officials point out, because the "saturation point" has been reached.

Today, there are 570 broadcasting stations, 28 of which are in the B class on

400 meters, the balance being on the more popular 360 meter wave. On January 1 there were 576, showing a loss of six during the month. While there were 28 new stations licensed in January, 34 old ones failed to renew their licenses.

On the first of February, last year, there were but 36 stations licensed in the new pastime of broadcasting—today there are almost 16 times that number. Many people believe that this is far too many, particularly since they are not well distributed on the 360 meter wave. The radio bill, however, provides for the distribution of a large number of new waves, which will aid in decreasing the interference. Competition is creeping into the game. The best equipped stations giving the best service to the fans will become the permanent ones in the long run, it is believed.

Sale of WDAP

WDAP, the popular station established by Thorne Donnelley and J. Elliott Jenkins under the company name of the Midwest Radio Central, Inc., and situated on the top floor of the Drake Hotel, Chicago, has been taken over by the Chicago Board of Trade.

Chicago being the center of the world's grain markets, the acquisition of this powerful station by the Board of Trade is an important radio item. It marks another step in the advance of radio into the important position wireless is assuming in commerce.

Announcement of the change in ownership was made on January 16. Following is a verbatim report of how the announcement was made:

"This is WDAP, now the official broadcasting station of the Chicago Board of Trade, located on the Drake Hotel, operated by the Midwest Central Radio, Inc.

"We shall now broadcast a few remarks to be made by the retiring president of the Chicago Board of Trade, Mr. Robert McDougal, during whose term of office the negotiations were made through which the Chicago Board of Trade will own this station.

"WDAP wishes to say to its friends that Messrs. Donnelley and Jenkins will continue to operate this station as in the past, so far as entertainment programs are concerned, under the direction of the Chicago Board of Trade Radio Committee.

"We announce Mr. Robert McDougal, retiring president of the Board of Trade of the City of Chicago.

Mr. McDougal said:

"This is certainly an unique experience. No former officer of the Chicago Board of Trade has ever greeted our patrons and friends in this manner, and I am very happy indeed to speak to those I cannot see on this epoch-marking occasion.

"My message to those interested in the commercial activities, centering on the Chicago Board of Trade, is brief. In this miracle manner we shall, as during the past few months, give to the entire radio public the official prices and other valuable information in connection with all commodities handled through this channel, thus serving the public from the farmer to the ultimate consumer. We hope to broaden our acquaintance, and demonstrate our proclamation that the Chicago Board of Trade is an open book that he who runs may read, and that prices are not made behind closed doors and available only to the few.

"The complete ownership and operation of this station will bring to our association, as such, no financial return; but we hope it will work to the mutual advantage of the members and their world-wide clientele.

"Nothing but authoritative facts and figures will be broadcasted on the commercial side, but we hope to enter the more human side of life through concerts as well as instructive addresses, which will be constructive as well, and we hope that the Chicago Board of Trade Radio Committee may have the pleasure of hearing from listeners who believe as we do—that this is a step forward in our endeavor to acquaint the public, in the grain business and out, with the operations of the world's greatest grain exchange and the largest international enterprise located in the Middle West."

The editor of Radio Age has received a letter from the Radio Committee of the Board of Trade further setting forth the aims of the Board as follows:

"Briefly stated, the policy of the Board of Trade for broadcasting station will be that of service and entertainment —service of the strictest, yet broadest character, to those who are interested in any phase of the grain business or other activities centering in this exchange.

"The entertainment feature will be of a dignified sort and as high a grade as possible, believing that we can in this way sell the idea that the Board of Trade of the city of Chicago is not an institution without a soul.

"Sticking absolutely to figures and facts, allowing no market opinion to be expressed and permitting no member of the Board of Trade, save the President and Secretary as officials, to go on the air, giving addresses from time to time through country-wide respected men and giving the radio public the best there is in the way of entertainment in the evening, with ball scores in season, will be our endeavor. There will be an iron clad rule against anyone going on the air, through this station, that would tend to reflect lack of dignity or discredit upon the Board of Trade or serve any individual member or firm in the way of advertising:

"It may be interesting for you to know that we received a letter from Hannibal, New York, stating that Mr. McDougal's address was heard very distinctly and enjoyed. It develops that Mr. McDougal's grand-parents and great-grandparents are buried in that town. So you can easily see that there is in it an interesting coincidence."

Ten Naval Radio Stations Closed

Secretary of the Navy Denby has directed that four Naval radio stations be sold, four others abandoned, and two radio compass stations be closed and dismantled. In carrying out the recent recommendations of the Rodman Board in the interests of increasing fleet efficiency, particularly in communication, the Secretary is disposing of unnecessary radio stations.

The stations at Cape May, N. J., will be closed and abandoned by Naval personnel at once, its work hereafter being handled by the station at Cape Henlopen. At Seattle, another station will be abandoned as soon as the Navy Yard at Puget Sound can take over the traffic. Grande Isle in Louisiana has been ordered closed and abandoned, as has also the station at Navassa Island in the West Indies.

Radio stations at Baltimore, Md., Mobile, Ala., Miami, Fla., and Port Arthur, Texas, will be offered for sale as soon as invitations for bids can be drawn up. It is also planned to dispose of the station at Managua, Nicaragua, when commercial facilities are provided at that place.

The War Department has been asked if it desires to take over any of the ten naval radio stations on the Great Lakes, but it is not likely that the Signal Corps will accept any except those at Buffalo and Cleveland. Such stations as the Army does not take over will remain closed. Radio compass stations at Pass a Loutre, La., and St. Petersburg, Fla., will be dismantled and the land vacated by the Navy. Several other stations are being held subject to abandonment as soon as the handling of existing traffic is arranged.

In closing the stations, the Navy Department does not desire to interrupt traffic in radio, but, on the other hand, as commercial traffic was only handled when other facilities were lacking, officers are of the opinion that commercial interests may now be induced to open general traffic stations at points previously covered by the Navy. The prime purpose of Naval shore radio stations is to aid the fleet, and when a station ceases to benefit the fleet, it becomes a liability to the Government instead of an asset.

Weather Forecasts

Additional weather forecasts and warnings will be broadcast from NAT, the Naval Radio Station at New Orleans, commencing on January 1. These broadcasts, on a wave of 1,832 meters are for the district included in Louisiana, Arkansas, Oklahoma and Texas, and comprise weather forecasts, river conditions, and a summary of the conditions over the United States twice daily. The schedule calls for a broadcast at 10:30 a. m. and 10:00 p. m. at 75th meridian time.

The Naval Communications Service has doubled its radio commercial rates. After April 1, all Naval stations requested to handle commercial messages will charge at the rate of twelve cents a word. It is hoped that this will relieve the department from further criticism. Emergency commercial service will be continued, however, where there are no other facilities.

Corrected List of U. S. Stations Alphabetically by Call Signals

Complete Each Issue

THE list of broadcasting stations on these pages is brought up to date each month by additions of new stations and deletion of those which have suspended operation. The list is the product of a vast volume of correspondence and its completeness is due in large measure to the assistance of our special news service in Washington, D. C. Suggestions, corrections and additional data will be welcomed from readers.

IXAD, Pawtucket, R. I., 300 and 600 meters; 1000 miles; Special license experimental; Standard Radio & Electric Co.
KUKA, E. Pittsburgh, Pa.; Class B station, up to 485 meters; Westinghouse Elec. & Mfg. Co.
KUN, San Francisco, Calif.; Leo J. Meyberg Co.
KDDW, Steamship America, New York.
KDPM, Cleveland, Ohio; Westinghouse Elec. & Mfg. Co.
KDPT, San Diego, Calif.; Southern Elec. Co.
KDYL, Salt Lake City, Utah; news music, entertainment, Telegram Publishing Co.
KDYM, San Diego, Calif.; Savoy Theatre.
KDYQ, Portland, Ore.; Oregon Inst. Technology.
KDYS, Great Falls, Mont.; Class B, 485 meters, Grest Falls Tribune
KDYV, Salt Lake City, Utah; Cope & Cornwell Co.
KDYW, Phoenix, Arizona; Smith Hughes & Co.
KDYA, Honolulu, Hawaii; Honolulu Star Bulletin Co.
KDZA, Tucson, Ariz.; Arizona Daily Star.
KDZB, Bakersfield, Calif.; Frank E. Seiffert.
KDZE, Seattle, Wash.; Rhodes Co.
KDZF, Los Angeles, Calif.; Automobile Club of Southern California.
KDZG, San Francisco, Calif.; Cyrus Pierce & Co.
KDZH, Fresno, Calif.; Fresno Evening Herald, Class B, 845.
KDZI, Wenatchee, Wash.; Electric Supply Co.
KDZK, Reno, Nev. Wednesday 8 to 9 p m; Friday 8 to 9 p m. Musical and newa features; Nevada State Journal, Nevada Machinery & Electric Co.
KDZL, Ogden, Utah; Rocky Mountain Rad. Corp.
KDZM, Centralia, Wash.; E. A. Hollingworth.
KDZQ, Denver, Colo.; Motor Generator Co.
KDZX, San Francisco, Calif.; Glad Tidings Tabernacle.
KDZZ, Everett, Washington; Kinney Bros. & Sipprall.
KFAD, Phoenix, Ariz.; Class B, 485, McArthur Bros. Mercantile Co.
KFAE, Pullman, Wash.; State Collega of Washington.
KFAF, Denver, Colorado; George S. Walker, Western Radio Corporation; musical programs, news items, etc., daily except Tuesday and Sunday, 8 to 9 p m; mountain standard time.
KFAJ, Boulder, Colo.; University of Colorado.
KFAN, Moscow, Idaho; Electric Shop.
KFAP, Butte, Mont.; Standard Pub. Co.
KFAQ, San Jose, Calif.; City of San Jose.
KFAR, Hollywood, Calif.; Studio Lighting Service Co.
KFAS, Reno, Nev.; Reno Motor Supply Co.
KFAT, Eugene, Ore. Monday, Wednesday and Saturday 8 to 9 p m Music; Sunday 8:30 to 9:15 Church Services; Pacific Radio Co.
KFAU, Boise, Idaho; Class B, 485, Boise High School.
KFAV, Venice, Calif.; Abbott Kinney Co.
KFAW, Santa Anna, Calif.; Class B, 485, Radio Den.
KFAY, Central Point, Ore.; W. J. Virgin Milling Co.
KFAZ, Reddley, Calif., C. H. Weatherll.
KFBB, Havre, Mont.; F. A. Buttrey & Co.
KFBC, San Diego, Calif.; W. K. Azbill.
KFBD, Hanford, Calif.; California Radio Lab.
KFBE, San Louis Obispo, Calif.; R. H. Horn.
KFBG, Tacoma, Wash.; First Presbyterian Church.
KFBH, Marshfield, Ore.; Thomaa Musical Co.
KFBK, Sacramento, Calif., 2,000 miles; daily, 3 to 4 p m and 6 to 6:30 p m; Sunday and Thursday 8 to 9 p m; Kimball-Upson Co. and Sacramento Union.
KFBL, Everett, Wash.; Leese Bros.
KFBU, Laramie, Wyo.; N. S. Thomas.
KFBV, Colorado Springs, Colo.; Clarence O. Ford.
KFCB, Phoenix, Ariz.; Nielson Radio Supply Co.
KFCC, Wallace, Ida.; Auto Supply Co.
KFCD, Salem, Ora.; F. S. Barton.
KFCF, Walla Walla, Wash.; Frank A. Moore.
KFCH, Billings, Mont.; Elec. Service Station.
KFCK, Colorado Springs, Colo.; Colorado Springs Radio Co.
KFCM, Richmond, Calif., Richmond Radio Shop.
KFCP, Ogden, Utah, Ralph W. Flygare.
KFCV, Houston, Tex., Fred Mahaffey, Jr.
KFDA, Baker, Ora.; Adler'a Music Store.
KFED, Billings Polytechnic Institute, Polytechnic, Mont.
KFDB, San Francisco, Calif.; Mercantila Trust Co., also 400.
KFDD, Boise, Idaho; St. Michael'a Cathedral.
KFDS, San Francisco, Calif.; John D. McKee.
KFEB, Taft, Calif.; City of Taft.
KFCQ, Casper, Wyo.; Motor Service Station.
KFDL, Denver, Colo.; Knight Campbell Music Co.
KFDJ, Corvallis, Ore.; Oragon Agri. College.
KFDC, Spokane, Wash.; Radio Supply Co.
KFDF, Casper, Wyo.; Wyoming Radio Corp.
KFEC, Portland, Ore.; Meier & Frank Co.
KFEL, Denver, Colo., Winner Radio Corp.
KFEP, Denver, Colo., Radio Equipment Co.
KFFA, San Diego, Calif.; Dr. R. C. Shelton.
KFCL, Los Angeles, Calif.; Los Angeles Union Stock Yards
KFEJ, Tacoma, Wash.; Guy Greason.
KFFE, Pendlaton, Ore.; Eastern Oregon Radio Co.
KFFQ, Colorado Springs, Colo., Marksheffel Motor Co.
KFGG, Astoria, Ore.; Astoria Budget.
KFGH, Stanford Univ., Calif.
KFHJ, Santa Barbara, Calif., Fallon Co.
KFGB, Pueblo, Co., Loewenthal Bro.
KFI, Los Angeles, Calif.; Earl C. Anthony, Inc.
KFU, Gridley, Calif.; The Precision Shop.
KFV, Yakima, Wash.; Foster-Bradbury Radio Store
KFZ, Spokane, Wash.; Doerr-Mitchell Elec. Co.
KGB, Tacoma, Washington, Tacoma Daily Ledger; H. F. Higgins
KGG, Portland, Ore.; Hallock & Watson Radio Service.
KGN, Portland, Ore.; Northwestern Radio Mfg. Co.
KGO, Altadena, Cal., 2500 miles; every Saturday 8 to 9:30 p m Musical program; Paul Franklin Johnson, Altadena Radio Lab.
KGU, Honolulu, Hawaii, Waikiki Beach, Marion A. Mulroney; Honolulu Advertiser
KGW, Portland, Ora.; Oregonian Pub. Co., also 400.
KGY, Lacay, Wash.; St. Martin's College, (Rev. S. Ruth),
KHD, Colorado Springs, Colo.; Class B, 485, C. F. Aldrich; Marble & Granite Co.
KHJ, Los Angeles, Cal; 400 metars, daily, 12:30 to 1:15 p m; from 7 to 7:30 p m and 8 to 9:30 p m; Los Angeles Times Mirror Co.
KHQ, Seattla, Wash.; Louis Wasmer.
KJJ, Sunnyside, Calif.; Tha Radio Shop.
KJQ, Stockton, Calif.; C. O. Gould.
KJS, Los Angelas, Calif.; Bibla Inst. of Los Angeles
KLB, Pasadena, Calif; J. J. Dunn & Co.
KLM, Del Monte, Calif.; Noggle Elec. Works.
KLP, Los Altos, Calif.; Colin B. Kennedy Co.
KFDH, Tucson, Ariz.; Univ. of Arizona.
KLS, Oakland, Calif.; Warner Bros.
KLX, Oakland, Calif.; Tribune Pub. Co.
KLZ, Denver, Colo.; Class B, 485, Reynolds Radio Co.
KMAZ, Macon, Ga., Mercer University.
KMC, Reedley, Calif.; Lindsay-Wetherill Co.
KMJ, Fresno, Calif. Max. 2576 Miles; Musical program, San Joaquin Light & Power Corp.
KMD, Tacoma, Wash., Love Electric Co.; Tacoma Times.
KNI, Eureka, Calif.; T. W. Smith.
KNJ, Roswell, New Mexico, 360, 485, 1000 milea; Every evening at 8; news, weather reports, stock market, concerts and sermons; Roswell Public Service Co.
KNN, Los Angeles, Calif.; Bullocks.
KNT, Aberdeen, Wash.; North Coast Products Co.
KNV, Los Angeles, Calif.; Radio Supply Co.
KNX, Los Angeles, Calif.; Elec. Lighting Supply Co.
KOA, Denver, Colo.; Y. M. C. A.
KOB, State College, N Mex. 485 also; time signals and weather reports 12 noon and 10: p m, mountain time; music and lectures Monday, Wednesday and Friday, 7:30 to 8:30 p m; New Mexico College of Agriculture and Mechanical Arts.
KOE, Spokane, Wash.; Spokane Chronicle.
KOG, Los Angeles, Calif.; Western Radio Electric Co.
KON, Los Angeles, Calif.; Holzwasser, Inc.
KOP, Detroit, Mich., Detroit Police Dept.
KOQ, Modesto, Calif., Modesto Evening News.
KPD, San Francisco, Calif., Hale Bros.
KQI, Berkeley, Calif., Univ. of California.
KQP, Hood River, Ore., Blue Diamond Elec. Co.; Hood River News.
KQV, Pittsburgh, Pa., Doubleday-Hill Elec. Co.
KQW, San Jose, Calif., Chas. D. Herrold
KQY, Portland, Ore; 1,000 miles, Monday, Tuesday, Saturday, 9 to 10 p m; Wednesday, Thursday, Friday, 6 to 7 p m; Stubbs Electric Co.
KRE, Berkeley, Calif., Maxwell Electric Co.
DSC, San Jose, Calif., O. A. Hale & Co.
KSD, St. Louis, Mo.; 1700 miles; 485 meters; grain, livestock, cotton, New York atocka, poultry and butter market, metal market, official weather and news at 9:40, 10:40, 11:40, 12:40, 1:40, 2:40 and 4 p m; 8: p m 400 meters, musical and other features; Pulitzer Publishing Co., St. Louis Post Dispatch.
KSL, San Francisco, Calif., The Emporium.
KSS, Long Beach, Calif., Preat & Dean Radio Research Lab.
KSU, Wenatchee, Wash., 360 and 485.
KTW, Seattle, Wash., First Presbyterian Church.
KUD, San Francisco, Calif., Examiner Printing Co., San Fran. Examiner.
KUS, Los Angeles, Cal. 500 miles; setting up exercises daily, 7 to 7:30 a m and 12:00 noon to 12:30 p m; concert, 65 voices, 6 to 6:45 p m, Wednesdays and Fridays; City Dye Works.
KUY, Del Monta Calif., Coast Radio Co.
KWG, Stockton, Cal. Daily Market reports, music and news 4 to 5 p m; Music, 2 to 3 p m, Sunday; Tueadays and Fridays, music, 8 to 9 p m. Portable Wireless Telephone Co.
KWH, Los Angeles, Calif., 485 also Los Angeles Examiner.
KXD, Modesto, Calif., Herald Publishing Co.
KXS, Los Angelea, Calif., Braun Corp.
KYI, Bakersfield, Calif., Alfred Harrell.
KYJ, Los Angeles, Calif., Leo J. Meyberg Co.
KYQ, Honolulu, T. H., Tha Electric Shop.
KYW, Chicago, Ill., Weatinghouse Elec. & Mfg. Co.
KZC, Seattle, Wash., Public Market & Dept. Store Co.
KZM, Oakland, Calif., Western Radio Inst.; Preston D. Allen.
KZN, Salt Laka City, Utah, Tha Deserat News.
KZV, Wenatchee, Wash., Wenatchee Battery & Motor Co.
NDF, Anacostia, D. C., 412 only, U. S. Navy Dept.
PWX, Havana, Cuba, Cuban Talephone Co.
WAI, Dayton, Ohio, McCook Field, U. S. Army.
WAAB, Naw Orleans, La., Valdemar Jensen.
WAAC, New Orleans, La., Tulane Univ.
WAAD, Cincinnati, Ohio, Ohio Mechanics Inat.
WAAF, Chicago, Ill., Chicago Daily Drovers Journal.
WAAE, St. Louis, Mo., St. Louis Chamber of Commerce.
WAAH, St. Paul, Minn.; Commonwealth Electric Co.
WAAJ, Boston, Mass., Eastern Radio Inst.
WAAK, Milwaukee, Wis., Gimbel Bros.
WAAL, Minneapolis, Minn., Minnesota Tribune Co. & Anderson-Beamish Co.
WAAM, Newark, N. J., 200 miles; musical and code, every week day 11 to 11:55 a m, 3 to 4 p m; Wednesday evenings 8 to 9; I. R. Nelson Company.
WAAN, Columbia, Mo., Univ. of Missouri.
WAAP, Wichita, Kans., United Elec. Co.; Otto W. Taylor.
WAAQ, Greenwich, Conn., New England Motor Sales Co.
WAAS, Decatur, Ga., Georgia Radio Co.
WAAT, Jersey City, N. J., Jersey Review.
WAAW, Omaha, Neb., Omaha Grain Exchange.
WAAY, Youngstown, Ohio, Yohrling Rayner Music Co.
WAAZ, Emporia, Kans.; Daylite 100 miles; nita 500-1000 miles; each Tuesday and Thursday from 7 to 8 p m. Acknowledga all communications at 7:15 p m. The Hollister Miller Motor Co.
WAH El Dorado, Kana., Midland Refining Co.
WAJT, Marshall, Mo., Kelly-Vawtor Jewelry Co.
WAJU, Yankton, S. D., Yankton College.
WBAA, W. Lafayette, Ind., Purdue University.
WBAD, Minneapolis, Minn., Sterling Elec. Co. & Journal Printing Co.
WBAE, Peoria, Ill., Bradlay Polytechnic Inst.
WBAF, Moorestown, N. J., Fred M. Middleton.
WBAG, Bridgeport, Pa., Diamond State Fibre Co
WBAH, Minneapolis, Minn., Tha Dayton Co.
WBAM, New Orleans, La., I. B. Rennyson.
WBAN, Paterson, N. J., Wireless Phone Corp.
WBAD, Decatur, Ill., James Millikin Univ.
WBAP, Fort Worth Tex. 400-485; 4000 miles; Markets and News; Feature concert Monday to Friday inclusive; 9:30 p m to 10:45 p m, Central Time; Quiet nights Saturday and Sunday. The Star-Telegram.
WBAQ, South Bend, Ind., Myron L. Harmon.
WBAU, Hamilton, Ohio, Republican Publishing Co.
WBAV, Columbus, Ohio, 485, also Erner & Hopkins Co.
WBAW, Marietta, Ohio, Marietta College.
WBAX Wilkes-Barre, Pa., John H. Stenger, Jr
WBL, Anthony, Kans., T. & H. Radio Co.

(Continued on next page.)

Corrected List of U. S. Stations Alphabetically by Call Signals

WBS, Newark, N. J., D. W. May, Inc.
WBT, Charlotte, N. C. 1200 miles; 11: a m weather report 485; 4:30 p m mechanical music; 8: p m Market Report; 8:30 Tuesday and Friday regular concert; 7:30 p m Sunday, Church Southern Radio Corp.
WBU, Chicago, Ill., City of Chicago.
WBZ, Springfield, Mass., Westinghouse Elec. & Mfg. Co.
WCAB, Newburgh, N. Y., Newburgh Daily News; Newburgh News Printing & Pub. Co.
WCAC, Fort Smith, Ark., John Fink Jewelry Co.
WCAD, Canton, N. Y., St. Lawrence University.
WCAE, Pittsburgh, Pa., 400 also; Kaufmann & Baer Co.
WCAE, Pittsburgh, Pa. 400 meter; 12:30 news and reports; 3:30 weather reports; 4:15 Closing Market reports; 7:30 Late news and lecture; 8:30 musical programs; Kaufmann Baer Co.
WCAG, New Orleans, La., Daily States Pub. Co.
WCAH, Columbus, O. Daily program 11:30 to 12:30; Every Tuesday evening at 7. musical program; C. A. Entrekin Electric Co.
WCAI, San Antonio, Texas, Southern Equipment Co.
WCAJ, Univ. Place, Neb., Nebraska Wesleyan University.
WCAK, Houston, Texas, Alfred P. Daniel.
WCAL, Northfield, Minn., St. Olaf College.
WCAM, Villanova, Pa., Villanova College.
WCAO, Baltimore, Md., Sanders & Stayman Co.
WCAP, Kalamazoo, Mich., Kalamazoo College.
WCAR, San Antonio, Texas, Alamo Radio Elec. Co.
WCAS, Minneapolis, Minn., Wm. H. Dunwoody Industrial Inst.
WCAT, Rapid City, S. Dak., 485 also South Dakota School of Mines.
WCAU, Philadelphia, Pa. 485 also; 1000 miles; Daily 10:30 a m; 2:30 p m; 6:30 p m; regular concert 10 to 12 noon; Tuesdays, Fridays, Saturdays; Durham & Co., Inc.
WCAV, Little Rock, Ark., J. C. Dice Elec. Co.
WCAW, Omaha, Nebr., Woodmen of the World.
WCAX, Burlington, Vermont, University of Vermont.
WCAY, Milwaukee, Wis., Kesselman O'Driscoll Co.
WCE, Minneapolis, Minn., Findley Elec. Co.
WCK, St. Louis, Mo., Stix Baer & Fuller.
WCM, Austin, Texaa, Univ. of Texas.
WCN, Worcester, Mass., 485 also Clark University.
WCX, Detroit, Mich., Detroit Free Press.
WDAC, Springfield, Ill., Ill Watch Co.
WDAE, Tampa, Fla., 485 also Tampa Daily News.
WDAF, Kansas City, Mo., 400 and 485, also Kansas City Star.
WDAG, Amarillo, Texas, K. Laurence Martin.
WDAH, El Paso, Texas, Mine & Smelter Supply Co.
WDAI, Syracuse, N. Y., 485 also Hughes Electrical Corp.
WDAJ, College Park, Ga., Atlanta & West Point R. R. Co.
WDAK, Hartford, Conn., Hartford Courant.
WDAL, Jacksonville, Fla., 485 also, Florida Times Union.
WDAO, Dallas, Texas, Automotive Elec. Co.
WDAP, Chicago, Ill., markets, 485; concerts 360; Daily on all business days: 9:30 a. m. receipts and shipments; estimated car lots; local weather report; opening futures market in wheat, corn, oats, rye, barley, pork, lard and ribs. 10 a. m. Future quotations, live stock receipts and prices; 10:30 a. m. futures quotations; 11 and 11:30 a m. same; 12 noon, futures and cash grain prices; 12:30 and 1 p. m. futures quotations; 1:20 p. m. closing futures quotations and high and low for day. Cash grain prices. Gross bids for cash grain to arrive. 6 p. m. closing quotations; news items. On Saturdays closing prices at 12:05 p. m. instead of 1:20 p. m. Visible supply changes sent when posted. Regular concert schedule 10 p. m. Tuesdays, Thursdays and Saturdays. Sunday eveninga 9 p. m. and 10 p. m. Chicago Board of Trade official station.
WDAG, Brownsville, Pa., Hartman-Riker Elec. & Mach.Co.
WDAR, Philadelphia, Pa., Lit Bros.
WDAS, Worcester, Mass., Samuel A. Waite.
WDAU, New Bedford, Mass., Slocum & Kilburn.
WDAX, Centerville, Iowa, First Nat'l Bank.
WDAY, Fargo, N. D., Kenneth M. Hance.
WDM, Washington, D. C., Church of the Covenant.
WDT, New York, N. Y., Ship Owners Radio Service.
WDV, Omaha, Nebr., John O. Yeiser, Jr.
WDZ, Tuscola, Ill., James L. Bush.
WEAA, Flint, Mich., Fallain & Lathrop
WEAB, Fort Dodge, Iowa, Standard Radio Equip. Co.
WEAC, Terre Haute, Ind., Baines Elec. Service Co.
WEAD, Atwood, Kans., Northwest Kansas Radio Supply Co.
WEAE, Blacksburg, Va., Virginia Polytechnic Inst.
WEAF, New York City, N. Y., Western Electric Co.
WEAG, Edgewood, R. I., Nichols-Hinelline-Bassett Lab.
WEAH, Wichita, Kans., Wichita Board of Trade and Lander Radio Co
WEAI, Ithaca, N. Y., Cornell University.
WEAJ, Vermilion, S. Dak., University of South Dakota.
WEAK, St. Joseph, Mo., Julius B. Abercrombie.
WEAM, North Plainfield, N. J., Burough of N. Plainfield.
WEAN, Providence, R. I., The Shepard Co.
WEAO, Columbus, Ohio, Ohio State University.
WEAP, Mobile, Ala., 485 also Mobile Radio Co.
WEAQ, Berlin, N. H., Y. M. C. A.
WEAR, Baltimore, Md., Balt. American & News Pub. Co.
WEAS, Washington, D. C., The Hecht Co.
WEAT, Tampa, Fla., John J. Fogarty.
WEAU, Sioux City, Iowa, Davidson Bros. Co.
WEAV, Rushville, Nebr., Sheridan Elec. Service Co
WEAW, Anderson, Ind., Arrow Radio Lab.
WEAX, Little Rock, Ark., T. J. M. Daly.
WEAY, Houston, Texas, Will Horwitz, Jr.
WEAZ, Waterloo, Iowa, Donald Redmond.
WEB, St. Louis, Mo., The Benwood Co., Inc.
WEH, Tulsa, Okla., Midland Refining Co.
WEV, Houston, Texas, 485 also Huriburt-Still Elec. Co.
WEW, St. Louis, Mo., 485 also St. Louis Univ.
WEW, St. Louis, Mo., 360 and 485; Market and weather reporta at 9: a m, 10: a m, 2: p m; no other regular program; St. Louis University.
WEY, Wichita, Kansas, 485 also Cosradio Co.
WFAA, Dallas, Texas, 400 and 485 also A. H. Belo & Co.
WFAW, Miami, Fla., 1500 miles; 7:30 to 9 p. m. concerts including Arthur Pryor's Band evenings and W. J. Bryan Sunday School, Sunday a m; Miami Daily Metropolis & Electrical Equipment Co.
WEAB, Syracuse, N. Y., C. F. Woese.
WFAC, Superior, Wis., Superior Radio Co.
WFAD, Salina, Kans., Watson Weldon Motor Supply Co.
WFAF, Poughkeepsie, N. Y., H. C. Spratley Radio Co.
WFAG, Waterford, N. Y., Radio Engineering Lab.
WFAH, Port Arthur, Texas, Elec. Supply Co.
WFAJ, Asheville, N. C., Hi-Grade Wireless Instrument Co.
WFAK, Brentwood, Mo., Domestic Electric Co.
WFAM, St. Cloud, Minn., 485 also Granite City Elec. Co. and Times Pub. Co
WFAN, Hutchinson, Minn., 485 also Hutchinson Electric Service Co.
WFAQ, Cameron, Mo., Cameron Radio Co. and Mo. Weslevan College
WFAS, Fort Wayne, Ind., United Radio Corp.
WFAT, Sioux Falls, S. Dak. 485; also Argus-Leader.
WFAU, Boston, Mass., Edwin C. Lewis.
WFAV, Lincoln, Nebr., 485 also Univ. of Nebr. Dept. of Elec. Engineering
WFAY, Independence, Kans., Daniels Radio Supply Co.
WFAZ, Charleston, S. Carolina, S. C. Radio Shop.
WFI, Philadelphia, Penn., 400 and 485, also Strawbridge & Clothier
WGAB, Houston, Texas, QRV Radio Co.
WGAC, Brooklyn, N. Y., Orpheum Radio Stores Co.
WGAD, Ensenada, Porto Rico, Spanish-American School of Radio-telegraphy
WGF, Des Moines, Iowa 300 miles; Musical and entertainment Tuesday and Friday 7:30 p m; Church Services Sunday at 5 p m or 7:45 p m as announced; Special programs as announced Register and Tribune.
WGAH, New Haven, Conn., New Haven Elec. Co.
WGAJ, Shenandoah, Iowa, W. H. Gass.
WGAK, Macon, Ga., Macon Elec. Co.
WGAL, Lancaster, Pa., Lancaster Elec. Supply & Construction Co.
WGAM, Orangeburg, S. C., Orangeburg Radio Equip. Co.
WGAN, Pensacola, Fla., Cecil E. Lloyd.
WGAQ, Shreveport, La., Glenwood Radio Corp.
WGAR, Fort Smith, Ark., Southwest American.
WGAT, Lincoln, Nebr., Am. Legion, Dept. of Nebr.
WGAU, Wooster, Ohio, Marcus G. Limh.
WGAV, Savannah, Ga., B-H Radio Co.
WGAW, Altoona, Pa., Ernest C. Albright.
WGAX, Washington Court House, Ohio, Ohio Radio Elec. Co.
WGAY, Madison, Wis., North Western Radio Co.
WGAZ, South Bend, Ind., South Bend Tribune.
WGI, Medford Hillside, Mass., 485, also Am. Radio & Research Corp.
WGL, Philadelphia, Pa., Thos. F. J. Howlett.
WGM, Atlanta, Ga., 400 only, Atlanta Constitution.
WGR, Buffalo, N. Y., 485 also Federal Tel. & Teleg. Co.
WGV, New Orleans, La., Interstate Elec. Co. 485 also.
WGY, Schenectady, N. Y., 400 and 485 also General Elec. Co.
WHA, Madison, Wis., 485 also Univ. of Wis.
WHAA, Iowa City, Ia; 500 miles; 8:30 p m, Monday, instruction; Tuesday, concert; Wednesday, popular lecture; Friday, University News; public lectures and concerts irregularly; State University of Iowa.
WHAB, Galveston, Texas, 300, 485, 600 also Clark W. Thompson (Fellman's Dry Goods Co.)
WHAC, Waterloo, Iowa, Cole Bros. Elec. Co.
WHAD, Milwaukee, Wis., 485 also; Marquette Univ.
WHAE, Sioux City, Iowa, Automotive Elec. Service Co.
WHAF, Pittsburgh, Pa., Radio Elec. Co.
WHAG, Cincinnati, Ohio, Univ. of Cincinnati.
WHAH, Joplin, Mo. 300 miles; Tuesday and Thursday nights 8 to 10; Hafer Supply Co.
WHAI, Davenport, Iowa, Radio Equip. & Mfg. Co.
WHAJ, Bluefield, W. Va., Bluefield Daily Telegraph and E. K. Kitts.
WHAK, Clarksburg, W. Va., Roberts Hdwe. Co.
WHAL, Lansing, Mich., Lansing Capitol News.
WHAM, Rochester, N. Y. 485 also; Daily—Weather report 2:40 p m; Organ 2:45, 5:00, 6:45; Orchestra 3:00, 7:00; Bed-time stories, Sport results, Business reports and market reports, the latter on 485 meters, 7:15 p m; Sunday—Radio Chapel Service, 3:15 p m; University of Rochester.
WHAO, Savannah, Ga., Frederick A. Hill; every evening 8 to 9; Saturday nights, 12:30 1:30 a. m.
WHAP, Decatur, Ill., Dewey L. Otta.
WHAQ, Washington, D. C., Semmes Motor Co.
WHAR, Atlantic City, N. J., Paramount Radio & Elec. Co.
WHAS, Louisville, Ky., Courier Journal and Louisville Times Co.
WHAV, Wilmington, Del., Wilmington Elec. Spec. Co.
WHAW, Tampa, Fla. 100 miles; 12 to 1, 4 to 5 p m, music; Pierce Electric Co.
WHX, Des Moines, Iowa; 300 miles; 5:45 p m to 6:15 p m Daily; 8:00 p m to 10 p m Wednesday evenings; Central Standard time; Iowa Radio Corp.
WHAY, Huntington, Ind., Huntington Press.
WHAZ, Troy, N. Y., 400 only, Rensselaer Polytechnic Inst.
WHB, Kansas City, Mo., 400 and 485 also Sweeney Auto & Tractor School.
WHD, Morgantown, W. Va., W. Va. University.
WHK, Cleveland, Ohio, Warren R. Cox.
WHN, Ridgewood, N. Y., Times Printing & Pub. Co.
WHU, Toledo, Ohio, Wm. B. Duck Co.
WIAB, Rockford, Ill., Joslyn Automobile Co.
WIAC, Galveston, Texas, 485 also Galveston Tribune.
WIAD, Ocean City, N. J., Ocean City Yacht Club.
WIAE, Vinton, Iowa, Mrs. Robt. E. Zimmerman.
WIAF, New Orleans, La., Gustave A. De Cortin.
WJAG, Norfolk, Nebr: 485 also; 200 miles News and Markets 12:15, 3:30 and 5:30 p m. The Huse Publishing Co. The Norfolk Daily News.
WIAH, Newton, Iowa, Continental Radio & Mfg. Co.
WIAI, Springfield, Mo., Heer Stores Co.
WIAJ, Neenah, Wis., Fox River Valley Radio Supply Co.
WIAK, Omaha, Nebr.; 485, 7:45 a m Livestock receipts; 9:10 a m Livestock receipts and opening on hogs; 10:15 a m rainfall and temperature report and weather forecast for Nebraska and Iowa, Livestock market; 12 m cattle, hog and sheep market; 1:50 p m rainfall and temperature report and weather forecast for Nebraska and Iowa; market detail; 3:50 p m complete market reports and estimated receipts for next day; Daily Journal-Stockman.
WIAO, Milwaukee, Wis., School of Engineering.
WIAP, Springfield, Mass., Radio Development Corp.
WIAQ, Marion, Ind., Chronicle Pub. Co.
WIAR, Paducah, Ky., Musical 3:30 to 4 p. m. and 7 to 8 p. m. except Sundays. Paducah Evening Sun; Albert Bennett, operator.
WIAS, Burlington, Iowa, Hawk-Eye Home Elec. Co.
WIAT, Tarkio, Mo., Leon T. Noel.
WIAU, Le Mars, Iowa, Am. Trust & Savings Bank.
WIAV, Binghamton, N. Y., N. Y. Radio Lab.
WIAW, Saginaw, Mich., Saginaw Radio & Elec. Co.
WIAX, Lincoln, Nebr., Capitol Radio Co.
WIAY, Washington, D. C., Woodword & Lothrop.
WIAZ, Miami, Fla., Elec. Supply Sales Co.
WIK, McKeesport, Pa., K. & L. Elec. Shop.
WIL, Washington, D. C., Continental Elec. Supply Co.
WIP, Philadelphia, Pa., Gimbel Bros.
WIZ, Cincinnati, Ohio, 485 also Cino Radio Mfg. Co.
WJAB, Lincoln, Nebr., American Radio Co.
WJAD, Waco, Texas, 485 also Jackson'a Radio Engrng. Lab.
WJAE, San Antonio, Texas, Texas Radio Syndicate.
WJAF, Muncie, Ind; 1800 miles; 7:30 to 8 Monday, Wednesday, Friday evening, music; 6:30 to 7 p m Saturday, music; 3:30 to 4 every afternoon, News: 10:30 to 12 M Sundays, Church service. Smith Electric-Muncie Press.
WJAJ, Dayton, Ohio 200 miles; Sunday 8:40, 9:15 Religious; Wednesday 9:15, 9:45 Entertainment; Friday 9:15 to 9:45 Entertainment. Y. M. C. A.
WJAK, Stockdale, Ohio, 485 also White Radio Lab.
WJAM, Cedar Rapids, Iowa, Evening Gazette.
WJAN, Peoria, Ill. Daily except Sunday; 9:15 a. m. official weather (185); 11:30 a. m. weather and markets (360) 1:30 p. m. market closo (360). Tuesday, Thursday and Saturdays: concerts at 9:15 p. m. Peoria Star.
WJAP, Duluth, Minn. 1500 miles; Sunday 11 a m, 12:30 p m Church Service and organ recital; First Methodist Church, Rev. Chas. N. Pace, Pastor. Monday 8: p m to 9 p m, musical; Thursday 8 p m to 9 p m, musical; Kelley Duluth Co.
WJAQ, Topeka, Kans., Capper Publications.
WJAR, Providence, R. I., The Outlet Co., J. Samuels & Bros
WJAS, Pittsburgh, Pa., Pittsburgh Radio Supply House.
WJAT, Marshall, Mo., Kelley-Vawter Jewelry Co.
WJAX, Cleveland, Ohio, 485 also Union Trust Co.
WJAZ, Chicago, Ill., Chicago Radio Lab.
WJD, Granville, O; 100 miles, music by Denison Conservatory, educational lectures and discussions; Denison University.
WJH, Washington, D. C., White & Boyer Co.
WJK, Toledo, Ohio, Service Radio Equipment Co.
WJX, New York, N. Y., De Forest Radio Telephone & Teleg. Co
WJZ, Newark, N. J., 485 also Westinghouse Elec. & Mfg Co
WKAA, Cedar Rapids, Iowa, 485 also H. F. Paar.
WKAC, Lincoln, Neb., Star Pub. Co.
WKAF, Wichita Falls, Texas, W. S. Radio Supply Co.
WKAG, Louisville, Ky., Edwin T. Bruce, M. D.
WKAH, West Palm Beach, Fla., Planet Radio Co.
WKAK, Okemah, Okla., Okfuskee County News.
WKAL, Orange, Texas, Gray & Gray.
WKAN, Montgomery, Ala., Alabama Radio Mfg. Co.
WKAP, Cranston, R. I., Dutee W. Flint.
WKAQ, San Juan, Porto Rico, Radio Corp. of Porto Rico.
WKAR, East Lansing, Mich., Mich. Agrl. College.
WKAS, Springfield, Mo., L. E. Lines Music Co.
WKAV, Laconia, N. H., Laconia Radio Club.

(Continued on next page.)

Corrected List of U.S. Stations Alphabetically by Call Signals

WKAW, Beloit, Wisc., Turner Cycle Co.
WKAX, Bridgeport, Conn., Wm. A. MacFarlane.
WKAY, Gainesville, Ga., Brenau College.
WKC, Baltimore, Md., Jos. M. Zamolski Co.
WKN, Memphis, Tenn., Riechman-Crosby Co.
WKY, Oklahoma City, Okla., 485 also Oklahoma Radio Shop.
WLZ, Fairfield, Ohio, U. S. Army.
WLAC, Raleigh, N. C., N. C. State College.
WLAF, Lincoln, Nebr., Johnson Radio Co.
WLAG, Minneapolis, Minn., Cutting & Walsh Radio Corp.
WLAH, Syracuse, N. Y., Samuel Woodworth.
WLAJ, Waco, Texas, 485 also Waco Elec. Supply Co.
WLAK, Bellows Falls, Vt., Vermont Farm Machine Co.
WLAL, Tulsa, Okla., Tulsa Radio Co.
WLAM, Springfield, Ohio, Morrow Radio Co.
WLAN, Houlton, Me., Putnam Hdwe. Co.
WLAP, Louisville, Ky., W. V. Jordan.
WLAQ, Kalamazoo, Mich., A. E. Schilling.
WLAR, Marshalltown, Iowa, Meikel Music Co.
WLAS, Hutchinson, Kans., Hutchinson Grain Radio Co.
WLAT, Burlington, Iowa, Radio Specialty Co.
WLAV, Pensacola, Fla.; daily musical program, 8 to 9 p m; The Electric Shop.
WLAW, New York, N. Y., New York Police Dept.
WLAX, Greencastle, Ind., Greencastle Community Broadcasting Station
WLAY, Fairbanks, Alaska, Northern Commercial Co.
WLAZ, Warren, Ohio, Hutton & Jones Elec. Co.
WLB, Minneapolis, Minn., Univ. of Minn.
WLK, Indianapolis, Ind., 485 also Hamilton Mfg. Co.
WLW, Cincinnati, Ohio, 485 also Crosley Mfg. Co.
WMA, Anderson, Ind., Arrow Radio Lab.
WMAB, Oklahoma City, Okla., Radio Supply Co.
WMAC, Cozenovia, N. Y, 750 miles; music 11; p m; Cleve B. Meredith.
WMAD, Rockport, Mo., Atchinson County Mail.
WMAE, Dartmouth, Mass., Round Hills Radio Corp.
WMAG, Liberal, Kans., Tucker Elec. Co.
WMAH, Lincoln, Nebr., General Supply Co.
WMAJ, Kansas City, Mo., 485 also Drovers Telegram.
WMAK, Lockport, N. Y., Norton Labs.
WMAL, Trenton, N. J, 100 miles; 7:30 to 9 p m, Mondays and Thursdays, musical programs, lectures etc; Trenton Hardware Co.
WMAM, Beaumont, Texas, Beaumont Radio Equip. Co.
WMAN, Columbus, Ohio, First Baptist Church.
WMAP, Easton, Pa., Utility Battery Service.
WMAQ, Fair Store Building, Chicago; 4:35 to 5 p m, daily; 7 to 7:30 p m, Monday, Wednesday, Friday and Saturday; 7 to 8 p m, Tuesday and Thursday; 9:15 to 10 p m daily; Chicago Daily News and Fair Department Store.
WMAR, Waterloo, Iowa, Waterloo Elec. Supply Co.
WMAT, Duluth, Minn., Paramount Radio Corp.
WMAV, Auburn, Ala., Polytechnic Inst.
WMAW, Wahpeton, N. D., Wahpeton Elec. Co.
WMAX, Ann Arbor, Mich., K. & K. Radio Supply Co.
WMAY, St. Louis, Mo., 600 miles; Religious services Sunday, 11 a m and 8 p m; Tuesday at 7 p m; Kingshighway Presbyterian Church.
WMAZ, Macon, Ga., Mercer University.
WMB, Auburn, Maine, Auburn Elec. Co.
WMH, Cincinnati, Ohio, 485 also Precision Equipment Co.
WMU, Washington, D. C., Doubleday-Hill Electric Co.
WNAB, Bowling Green, Ky., Park City Daily News.
WNAC, Boston, Mass.; Monday 4 to 5 p. m. (silent at night) Tuesday 4 to 5 p. m. and 7 to 8:30 p. m. Wednesday 4 to 5 p. m. 9:30 to 11 p. m. Thursday 4 to 5 and 7 to 8:30 p. m. Friday 4 to 5 and 8 to 9:30 p. m. Saturday 4 to 5 and 9:30 to 11 p. m. The Shepard Stores; J. J. Fanning, announcer; Samuel Curtis, operator.
WNAD, Norman, Okla., Okla. Radio Engineering Co.
WNAF, Enid, Okla., Enid Radio Dist. Co.
WNAH, Manhattan, Kans., Manhattan Radio Supply Co.
WNAL, Omaha, Nebr., R. J. Rockwell.
WNAN, Syracuse, N. Y., Syracuse Radio Telephone Co.
WNAP, Springfield, Ohio, Wittenberg College.
WNAQ, Charleston, S. C., Charleston Radio Elec. Co.
WNAS, Austin, Texas, Radio Corp.
WNAT, Philadelphia, Pa. 1000 miles; Talks, Radio information, music, Chapel Service. Wednesday 7:30 p m; Saturday 7:30 p m; Sunday 2:30 and 4:30; Every day 12:15, 1 p m. Lennig Bros. Co.
WNAV, Knoxville, Tenn., People's Tel. and Tel. Co.
WNAY, Baltimore, Md., Shipowners' Radio Service.
WNAX, Yankton, S. D., Dakota Radio Apparatus Co.
WNAW, Fortress Monroe, Va., Henry Kunzman.
WNJ, Albany, N. Y., Shotton Radio Mfg. Co., Inc.
WNO, Jersey City, N. J., Wireless Telephone Co. of Hudson Co., N. J.
WOAA, Omaha, Nebr, 100 miles; Woodmen of the World.
WOAA, Ardmore, Okla., Dr. Walter Hardy.
WOAC, Lima, Ohio, Maus Radio Co.
WOAE, Fremont, Nebr., Medland College.
WOAF, Tyler, Texas, Tyler Commercial College.
WOAH, Charleston, S. C., Palmetto Radio Corp.
WOAI, San Antonio, Tex. 485 also; daily except Sunday 10:30, 12:15, 3, 6 p m, News, market, weather reports; Wednesday, Concert 7:30 to 8:30 p m; Sunday evening concert 9:30 to 10:30 p m; Southern Equipment Co. and The Evening News and The Express.
WOAJ, Parsons, Kans., Erving's Electrical Co.
WOAK, Frankfort, Ky., Collins Hardware Co.
WOAL, Webster Groves, Mo., Wm. E. Woods.
WOAN, Lawrenceburg, Tenn., James D. Vaughan.
WOAR, Kenosha, Wis., Henry P. Lundskow.
WOAS, Middleton, Conn., Bailey's Radio Shop.
WOAT, Wilmington, Del., Boyd Martell Hamp.
WOAU, Evansville, Ind., Sowder Bolling Piano Co.
WOAV, Erie, Pa., Pa. Nat'l Guard.
WOAX, Trenton, N. J., Franklin J. Wolff.
WOAY, Birmingham, Ala., John W. Wilder.
WOAQ, Portsmouth, Va., Portsmouth Radio Ass'n.
WOAW, Omaha, Neb., 100 miles, Woodmen of the World.
WOAZ, Stanford, Texas, Penick Hughes Co.
WOC, Davenport, Ia, 485 meters; time signals, 10:55 a m; weather 11 a m; 360 meters, 11:05 opening market quotations, agriograms; 12:00 noon, chimes concert; 2:00 p m, closing stocks and markets; 3:30 p m, educational talk; 5:45 p m chimes concert; 6:35, sandman's visit; 7:00 musical program; 8 p m, lecture; Sundays, religious and musical and religious features, 9 a m to 10 p m; Palmer's School of Chiropractic.
WOH, Indianapolis, Ind., Hatfield Elec. Co.
WOI, Ames, Ia., 485 also Iowa State College.
WOK, Pine Bluff, Ark., concerts Tuesday and Friday evenings beginning at 9; Sundays, song service and sermons from churches at 11 a. m. and 7:30 p. m., Arkansas Light & Power Co.
WOO, Philadelphia, Pa., 400 and 485 also, John Wanamaker.
WOQ, Kansas City, Mo., 485 also Western Radio Co.
WOR, Newark, N. J., 400 only, L. Bamberger & Co.
WOS, Jefferson City, Mo. 485 also; first fifteen minutes of every hour from 8: a m to 2: p m; 5 p m, markets and music, 360 meters; Monday, Wednesday, Friday nights, 8 to 9:30 concerts; no Sunday program; Missouri State Marketing Bureau.
WOV, Omaha, Nebr., R. B. Howell.
WOU, Omaha, Nebr., Metropolitan Utilities.
WOZ, Richmond, Ind., 485 also Palladium Printing Co.
WPA, Fort Worth, Texas, 485 also Fort Worth Record.
WPAA, Wahoo, Neb., Anderson & Webster Elec. Co.
WPAB, State College, Pa.
WPAC, Okmulgee, Okla., Donaldson Radio Co.
WPAD, Chicago, Ill., Wieboldt & Co.
WPAF, Council Bluffs, Iowa, Peterson's Radio Co.
WPAG, Independence, Mo., Central Radio Co.
WPAH, Waupaca, Wis., Wisconsin Dept. of Markets.
WPAJ, New Haven, Conn., Doolittle Radio Corp.
WPAK, Fargo, N. D., North Dakota Agricultural College.
WPAL, Columbus, Ohio, Superior Radio & Tel. Equip. Co.
WPAM, Topeka, Kans., Awerbach & Guettel.
WPAP, Winchester, Ky., Theo. D. Phillips.
WPAQ, Frostburg, Md., General Sales & Eng. Co.
WPAQ, Wilmington, Del., Radio Installation Co., Inc.
WPAR, Beloit, Kans., R. A. Ward.
WPAS, Amsterdam, N. Y., J. & M. Electric Co.
WPAT, El Paso, Texas, St. Patrick's Cathedral.
WPAU, Moorhead, Minn., Concordia College.
WPAV, Laurium, Mich., Paul Tinetti & Sons.
WPAX, Thomasville, Ga., S. W. Radio Co., J. R. Shumate, Jr.
WPAY, Bangor, Me., Bangor Radio Laboratory.
WPAZ, Charleston, W. Va., Dr. John R. Koch.
WPE, Independence, Mo.
WPG, New Lebanon, Ohio 1500 miles; Program exclusive for the farmer; 12 to 12:15 p m News Flashes; 6 to 6:30 p m, News, Markets; 8 to 9:45 Monday and Wednesday; music and farm program. Nushawg Poultry Farm.
WPI, Clearfield, Pa., Elec. Supply Co.
WPM, Washington, D. C., Thos. J. Williams, Inc.
WPO, Memphis, Tenn., United Equip. Co.
WQAA, Parkersburg, Pa. 1500 miles; 10:30 p m every evening. Horace A. Beale, Jr.
WQAB, Springfield, Mo., Southwest Missouri State Teachers' College.
WQAC, Amarillo, Texas, E. B. Gish.
WQAD, Waterbury, Conn., Whitall Electric Co.
WQAE, Springfield, Vt., Moore Radio News Station,
WQAF, Sandusky, Ohio, Sandusky Register.
WQAH, Lexington, Ky., Brock-Anderson Elect. Eng Co.
WQAJ, Ann Arbor, Mich., Ann Arbor Times-News.
WQAK, Dubuque, Iowa, Appel-Higley Elec. Co.
WQAL, Mattoon, Ill., Cole County Tel. and Tel. Co.
WQAM, Miami, Fla., Electrical Equipment Co.
WQAO, New York, N. Y., Calvary Baptist Church.
WQAP, Lincoln, Nebr., Am. Radio Co.
WQAQ, Abilene, Texas, West Texas Radio Co.
WQAR, Muncie, Ind., Press Publishing Co.
WQAW, Scranton, Pa., Scranton Times.
WQAY, Hastings, Nebr., Gaston Music & Furniture Co.
WQX, Chicago, Ill., Riverview Park, Walter A. Kuehl.
WRAA, Houston, Texas, Rice Institute.
WRAC, Mayville, N. D., State Normal School.
WRAD, Marion, Kansas. Taylor Radio Shop.
WRAJ, Pittsburgh, Penn., M. H. Pickering Co.
WRAM, Carthage, Ill., Robert E. Compton & Carthage College.
WRAM, Galesburg, Ill., Lombard College.
WRAN, Waterloo, Iowa, Black Hawk Elec. Co.
WRAO, St. Louis, Mo., Radio Service Co.
WRAU, Amarillo, Texas, Daily News.
WRAV, Yellow Springs, O., Antioch College.
WRAY, Scranton, Pa., Radio Sales Corp.
WRK, Hamilton, Ohio, Doron Bros. Elec. Co.
WRL, Schenectady, N. Y., Union College.
WRM, Urbana, Ill., Univ. of Ill.
WRP, Camden, N. J., Federal Inst. of Radio Telg.
WRR, Dallas, Texas, 485 also City of Dallas, Police and Fire Signal Dept.
WRW, Tarrytown, N. Y., Koenig Bros., Tarrytown Radio Research Lab.
WSAA, Marietta, O., B. S. Sprague Electric Co.
WSAB, Cape Girardeau, Mo., Southeast Mo. State College.
WSAJ, Grove City, Pa., Grove City College.
WSAS, Lincoln, Nebr., State of Nebr.
WSAT, Plainview, Texas, The Plainview Electric Co.
WSAV, Houston, Texas, C. W. Vick Radio Const'n Co.
WSB, Atlanta, Ga., 400 and 485 Atlanta Journal.
WSL, Utica, N. Y., J. & M. Elec. Co.
WSY, Birmingham, Ala., Alabama Power Co.
WTAC, Johnstown, Pa., Penn. Traffic Co.
WTAU, Tecumseh, Neb., Ruegy Battery & Elec. Co.
WTAW, College Station, Texas, Agricultural and Mechanical College of Texas.
WTG, Manhattan, Texas, Kans. State Agri. College.
WTP, Bay City, Mich., Ra-Do Corp.
WVP, New York, N. Y. Signal Corps, U. S. Army.
WWAC, Waco, Tex; 3000 miles; Weather forecasts 11 a m daily; musical concerts, daily, 1:30 p m and on Wednesday and Saturday evenings at 8; Sanger Bros.
WWAD, Philadelphia, Pa., Wright & Wright, Inc.
WWAX, Laredo, Texas, Worman Bros.
WWB, Canton, Ohio, Daily News Printing Co.
WWI, Dearborn, Mich., Ford Motor Co.
WWJ, Detroit, Mich., 400 485, Evening News.
WWL, New Orleans, La., Loyola Univ.
WWX, Washington, D. C., Post Office Dept.
2XAI, Newark, N. J., Westinghouse Elec. & Mfg. Co.
2XI, New York City, A. T. & T. Co.
2XJ, Deal Beach, N. J., Amer. Tel. & Telg. Co.
3XW, Parkersburg, Pa., Horace A. Beale, Jr.
3YN, Washington, D. C., Nat'l Radio Inst.
9ARU, Louisville, Ky., Darrell A. Downard.

Report of Conference on Radio Standardization

Engineering Societies Building, New York, N. Y., January 12, 1923.

THIS conference was called by the U. S. Bureau of Standards in cooperation with the American Engineering Standards Committee, at the request of:

The Institute of Radio Engineers.

The National Radio Chamber of Commerce.

The Radio Apparatus Section, Associated Manufacturers of Electrical Supplies.

The National Retail Dry Goods Association.

The American Radio Relay League.

Radio Corporation of America.

Dr. F. C. Brown, Acting Director of the Bureau of Standards, presided.

Dr. J. H. Dellinger, Chief of the Radio Laboratory of the Bureau of Standards, showed how the widespread interest in radio had brought with it an increasing demand for uniformity and dependability in the radio service and apparatus. The lack of any such standardization has been brought to the attention of the Bureau of Standards by producer, distributor, and consumer. There has not previously been a concerted movement to introduce standardization by joint action of all radio interests.

Dr. A. N. Goldsmith, Secretary of the Institute of Radio Engineers, stated that while standardization involves the danger of stagnation and possible excessive monotony in the resulting product, it is only by a reasonable amount of standardization along wise directions that gross abuse of public confidence can be avoided. The purchasers of radio sets and the dealers who handle them are all entitled to protection against vague or misleading descriptions of apparatus which is bought and sold.

Mr. William H. Davis, President of the National Radio Chamber of Commerce, expressed the belief that the radio industry is today in a situation where it must be careful or else lose the respect of the public. Fortunately the industry has shown a desire to get together in reconciling cooperation and individuality.

Mr. J. M. L. Hogan, consulting radio engineer, emphasized the need for education not merely of the consumers but of the manufacturers and dealers, and perhaps of the engineers. Trouble can be avoided by all adopting the same language and describing things in the same way. Among the radio instruments needing standardization are wavemeters, condensers, inductors, telephone receivers, and loud speakers. Mr. Hogan expressed the hope that this conference would result in the formation of a national committee which would at least formulate standards of practice to be recommended.

Dr. P. G. Agnew, Secretary, American Engineering Standards Committee, described the function of that committee as to the provision of machinery for passing from the stage of standardization by societies or associations to standardization on a national scale. This is accomplished through a sectional committee on which each organization having a real interest in the standard under consideration is given an opportunity to participate. It is provided also that there shall be a reasonable balance between the different interests involved, neither the manufacturers, distributors, nor consumers having a majority on this committee except by the consent of the others.

Admiral Ziegemeier, Director of Naval Communications, spoke of the interest of the Navy Department as a large user of radio equipment, and urged the importance of giving full consideration to radio communication with ships and other isolated places. Mr. K. B. Warner said that the American Radio Relay League is glad to assist in this development looking toward the betterment of the art, and expressed hope that they would be a definite help on account of their long practical field experience in the use of apparatus. Mr. William A. Fitzgerald told of the interest of the National Retail Dry Goods Association in the development of tests for the standardization of radio apparatus, particularly receiving sets. Mr. M. C. Rypinski of the Associated Manufacturers of Electrical Supplies, Radio Apparatus Section, expressed the view that the conference should turn its attention mainly to the standardization of radio apparatus and radio broadcasting itself rather than undertaking commercial dimensional standardization which might interfere with the development of the art. Mr. A. H. Griswold, of the American Telephone & Telegraph Co., spoke of the necessity of keeping problems of regulation separate from those of standardization.

The conference then proceeded to the consideration of the agenda, which consisted of the following questions:

(1) Shall a formulation of standards for radio apparatus and service be made?

(2) What type of standardization should be initiated; thus what general classes of apparatus or service, or what specific parts should be considered most important to include in such standardization?

(3) What features should be covered in formulating standards for radio apparatus.

(a) Methods of rating; (b) methods of testing; (c) dimensional standardization; (d) specifications for general requirements; (e) specifications for purchase; (f) specifications for safety.

(4) Should steps be taken to provide testing facilities?

(5) What shall be the procedure recommended for carrying out the conclusions reached by this conference?

(6) What general recommendations should be made to a continuing committee should such a committee be established?

(7) What consideration should be given to related lines of activity? (e. g., standardization of terms and symbols).

After other brief talks on the need for standardization in radio by a number of the representatives present, it was voted that action should be taken toward the formulation of standards for radio apparatus and service.

The conference then proceeded to consideration of the procedure for carrying out the conclusions which it might reach. The discussion developed the fact that the procedure of the American Engineering Standards Committee is very suitable for the formulation of radio standards. A general discussion followed on the desirability of having a single sectional committee or two sectional committees, one for dealing with questions of nomenclature and methods of measurement and testing, the other for dealing with commercial standardization. It was voted that a single sectional committee should be formed to carry on all phases of radio standardization.

The conference then took up the question of sponsorship for this undertaking, it being required under the American Engineering Standards Committee procedure that one or more organizations be selected as sponsor to be responsible for the formulation of the particular standard or group of standards and to organize the sectional committee. The organizations suggested as sponsors were the Institute of Radio Engineers, the American Institute of Electrical Engineers, and the Bureau of Standards. A number of persons spoke, urging the sponsorship of these organizations, some favoring separate and others joint sponsorship. A motion to make the three organizations joint sponsors lost by a vote of thirty to eight. A motion to make the Bureau of Standards sole sponsor carried by a vote of twenty-six to sixteen. The Chairman pointed out the need of a more nearly unanimous selection on the part of the conference if this standardization project is to succeed. A motion to reconsider having carried, it was suggested that an informal vote on all possible combinations of the three suggested sponsors be taken. This informal vote resulted as follows:

A. I. E. E. and I. R. E.	29
Bureau of Standards	19
I. R. E.	17
B. S. and I. R. E.	12
A. I. E. E., B. S. and I. R. E.	7
A. I. E. E. and B. S.	00
A. I. E. E.	0

A formal motion that the American Institute of Electrical Engineers and the

Institute of Radio Engineers be selected as joint sponsors carried by a vote of thirty-two to five. On motion by Dr. Brown this vote was made unanimous.

Motions were carried leaving to the Sectional Committee the decision as to the type and scope of the standardization to be undertaken immediately, including the consideration of testing facilities and other related lines of activity.

Dr. A. N. Goldsmith and Mr. L. T. Robinson having consulted with one another in behalf of the Institute of Radio Engineers and the American Institute of Electrical Engineers, respectively, made a statement acknowledging the expression of confidence in the organizations shown by the action of the conference. They appointed the following advisory committee to assist in the organization of the sectional committee and the necessary technical sub-committees:

For the Department of Commerce, Dr. J. H. Dellinger and Mr. L. E. Whittemore.

For the Navy, Commander S. C. Hooper.

For the Army, Major L. B. Bender.

For the National Radio Chamber of Commerce, Mr. G. H. Lewis.

For the Radio Section of the Associated Manufacturers of Electrical Supplies, Mr. M. C. Rypinski.

For the National Retail Dry Goods Association, Mr. Wm. A. Fitzgerald.

For the Pacific Radio Trade Association, Mrs. Max Loewenthal.

For the Consulting Engineers, Mr. J. V. L. Hogan.

For the American Radio Relay League, Mr. K. B. Warner.

As a representative of the Standardization Committee of the Institute of Radio Engineers and former member of the American Institute of Electrical Engineers Standardization Committee, Mr. Donald McNicol.

For the Institute of Radio Engineers, Dr. A. N. Goldsmith.

For the American Institute of Electrical Engineers, Mr. L. T. Robinson.

The action of the conference may be summarized by stating that it agreed unanimously (1) that standards for radio apparatus and service should be formulated, and (2) that a broadly representative national committee on radio standardization should be formed under the leadership of the Institute of Radio Engineers and the American Institute of Electrical Engineers following the procedure of the American Engineering Standards Committee.

Some Congressmen seem to think that radio can be laid out like pastures or grazing lands with neat wire fences which would keep the broadcasts and messages within the confines of a state. Two of them actually believe that State rights are involved in the White-Kellogg Bill and want local radio control left with the state governments. DX's, take notice!

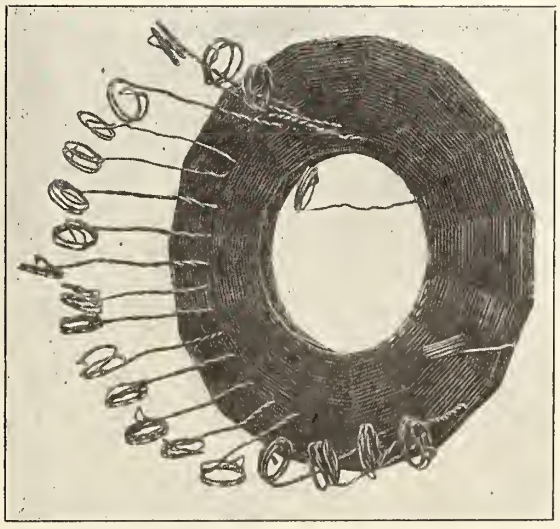
Bathing by radio is one of the last broadcasts from the Public Health Service, but whether *ether waves* were recommended was not made known.

THE remarkable efficiency, sharp-tuning, and responsiveness to distant signals of this form of inductance is due to:

1. Absence of wood, fibre, or any other insulating substance, from the magnetic field, thereby eliminating loss of energy through dielectric absorption.

2. Inductance is concentrated in one small space.

3. Dimensions and spacing of turns give lowest possible distributed capacity and maximum pure inductance.



Tapped According to any Specification.

PFANSTIEHL RADIO SERVICE COMPANY
Highland Park, Ill.

Chicago Sales Office, 33 So. Clinton St.
Telephone: Franklin 2473.

Symbols Used in Radio Diagrams

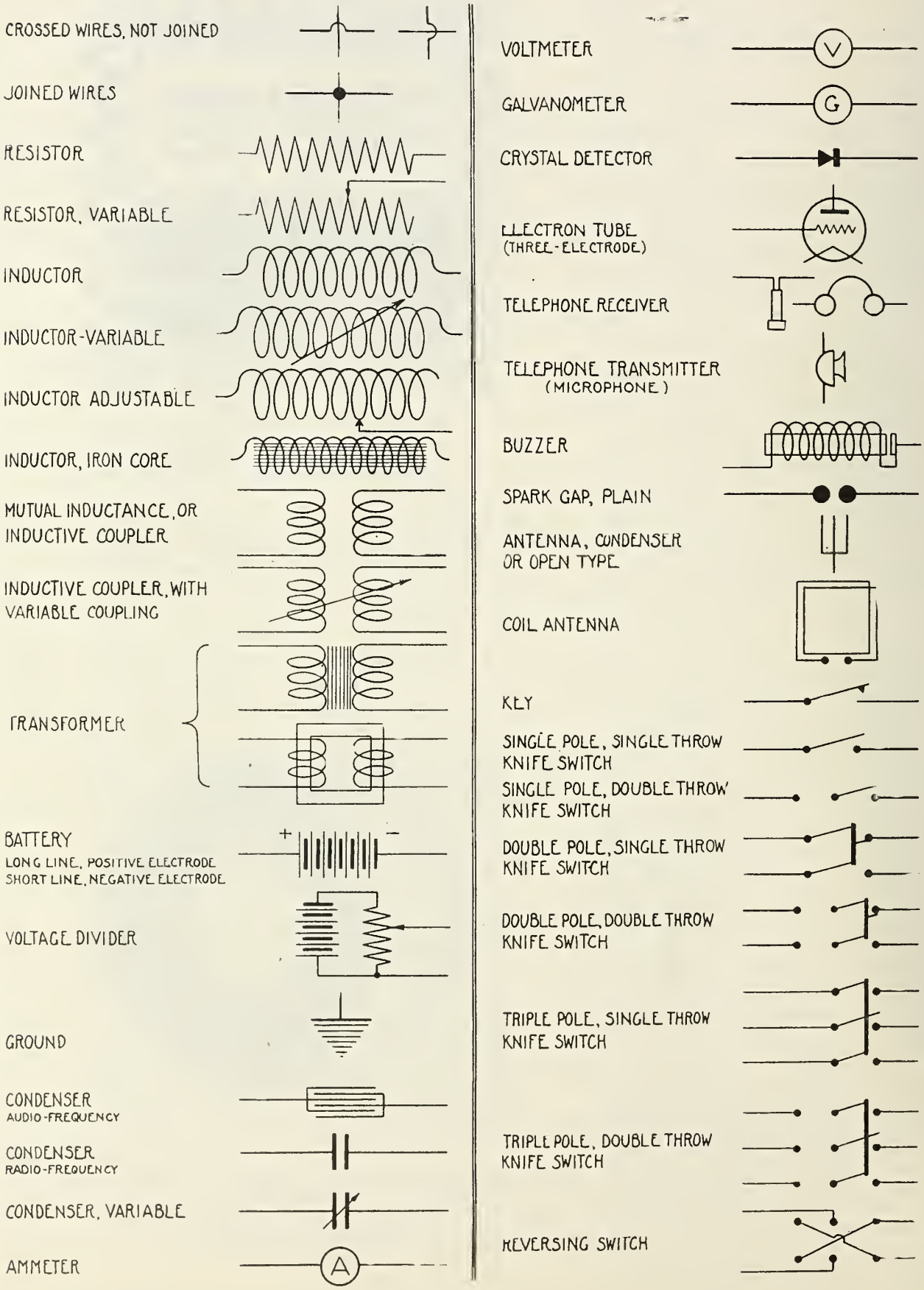


FIG. 4.

Scribes Get New Set

A new Radiola Grand, one of the first of the latest developments in radio receiving sets made by the Westinghouse Electric Company, has been presented to the National Press Club in Washington. With this new set, which has a larger wave range and longer reception radius than the old set, many of the Washington correspondents whose papers broadcast, now tune in the "home station." Broadcasters in the Middle West and far South have been brought in since the new set has been in operation. Theodore Tiller, well-known representative of the Atlanta Journal, which broadcasts from WSB, was much disappointed the other day when told that he was paged by radio the night before. His paper put on a special program for him, announcing it over the radio and calling for him to listen in. He was not in the club, however, and missed out.

The Westinghouse Company plans to present new sets to several members of the cabinet interested in radio, according to Mr. E. L. Norcross, local representative, who has already installed a set for Secretary Weeks in the War Department.

The new installation is a big improvement on the old one-dial set, as it enables better tuning. It consists of a two-stage amplifier, transformer coupled, using a push and pull circuit on the second stage, which gives a smoother quality to the tone of the signals and eliminates a large amount of distortion. The loud speaker is also a new device and prevents "blasting." The horn and tubes are mounted on shock absorbers, and the tubes, which are of the now 1 1-2 volt variety, are operated from four dry cells. They are WD-11 tubes.

Audion Amplifier

(*Continued from page 14.*)

to amplifier No. 2. The wire is reconnected to the "output" binding post of amplifier No. 1. The connections are now as shown in Fig. 3.

If the crystal detector is used in place of the electron tube detector unit the same general scheme of testing is followed.

8. Suggestions to Students.

The person who desires to study radio receiving sets further than what has been given in this series on very simple apparatus will find useful information in "The Principles Underlying Radio Communication," previously referred to, and in the periodicals and books listed in Bureau of Standards Circular, No. 122, "Sources of Elementary Radio Information." Both publications are obtainable from the Superintendent of Documents, Government Printing Office, the former at $1.00 and the latter at 5 cents.

In text books and articles generally, the parts of radio apparatus are represented by conventional symbols. For the assistance of the student, Fig. 4 of this pamphlet shows the more common symbols which are extensively used in diagrams of apparatus and circuits. One should be familiar with these in order to read circuit diagrams.

Havana-East Pittsburgh

Havana, like the rest of the world, is imbued with the wireless spirit and has any number of radio enthusiasts. Among those who "listen-in" nightly for the music and voices that fly through the air is J. W. White, Manager of the Westinghouse Electric International Company, with offices in the Edificio Banco Nacional de Cuba.

Mr. White has been a radio enthusiast since radiophone broadcasting was started on a large scale. It is a fact that almost every night, KDKA, the radiophone broadcasting station located in East Pittsburgh, Pennsylvania, U. S. A., about 1,500 miles away, as the crow flies, is picked up on Mr. White's receiver and the entertainment played so far away is enjoyed at the White residence. Three things are responsible for this extremely long-distance reception of radiophone broadcasting; great range of the sending station, the excellence of the receiver and the favorable atmospheric conditions that are found in Havana.

Mr. White uses a radio receiver known as the RC set manufactured by his company. It consists of a very sensitive tuner, with a vacuum tube detector and two stages of amplification. Many long distance records in radio reception have been made by this receiver but Mr. White's record is as good as the best.

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With the Radio Trade

Spider Web Coils

By EUGENE T. TURNEY

Imitation is the sincerest form of flattery, and the way some people have been exploiting Spider Web Coils, which I was the first to develop and patent, has somewhat stimulated my pride. It does not seem to be generally known that Spider Web Coils are a patented article, as is the machine with which they are wound, and that the name "Spider Web" is protected by trademark, all of which are controlled by my company.

Prior to 1921 little or nothing was known in this country of spiral or stagger wound coils and it was only after a trip I had made out West that it occurred to me that a coil properly constructed on these principles might prove efficient for radio purposes. While riding through the rural districts, my attention was attracted to the telephone wires crossing each other at stated intervals, and I resolved on my return to New York that I would consult an old friend of mine, a telephone engineer, who told me that if it were not for the crossing of these wires, long distance telephony would not be possible owing to the distributed capacity increasing as the line lengthened and that these crossings or transpositions had a strong tendency to break it up.

It occurred to me right then and there that an inductance coil constructed on this principle would be ideal for radio purposes. I learned the British had made some experiments along these lines without avail, which I found was due to the method employed in designing the core and laying on the wire. This failure, however, did not dampen my ardor and I set out to produce a coil I knew would be ideal, could the proper conditions be brought about, and whether or not I have succeeded can best be judged from the way Spider Web Coils, as I have named them, have leaped into prominence.

You will probably be interested to know that Spider Web Coils, when wound by hand, are no better than any other form of winding. The real merit in Spider Web Coils is produced by machine-spaced layers, which together with the proper number of transpositions reduces the distributed capacity more than any other known method.

For example, a coil of the duolateral type, having an inductance of 300 millihenries, will have a distributed capacity of about 21 micro micro farads, while a coil of the same inductance of Spider Web winding will have a distributed capacity of 4.6 micro micro farads, which is more than 500 percent less. You can readily see from the above that Spider Webs are much more efficient, owing to this difference. The lower the distributed capacity in the coil, the nearer you can approach a zero tuning with condensers in the circuits. It also means greater distance covered, more selectivity, less distortion and clearer signals.

There is as much difference between a properly wound Spider Web and the ordinary form of winding as there is between day and night.

Panels in Stock Sizes

Fifteen convenient stock sizes have been brought out by the makers of Radion panels. This is an addition of five stock sizes over the number they have been manufacturing for the past year. Developments in the radio industry have indicated that fifteen stock sizes fullfil almost every demand of the man who builds his own set, and greatly simplifies distribution by jobber and dealer alike. Beginning at the smallest panel, 6x7 inches, they appear in increasing lengths, such as 6x10 1-2, 6x14, 6x21, 7x18, 7x24, 11x12 and 12x14. The smaller sizes are 3/16 inches thick while the larger sizes, as 14x18 and 20x24, can be had in 3/16 and 1/4 inch thickness.

Neither the dealer nor his customer now has the waste and trouble occasioned by sawing panels from large sheets. The exact or approximate size of Radion panel, individually enveloped to protect the highly polished surface, with full directions for sawing, drilling, etc., can be selected and sold over the counter to the buyer. Radion panels are regularly supplied in two colors, black and mahoganite, the latter being a beautiful imitation of genuine mahogany grain. The surfaces of both colored panels have beautiful satin-like polishes. An illustrated booklet may be obtained from the American Hard Rubber Company, 11 Mercer Street, New York City.

Precision Sells Out

Powel Crosley, Jr., President of the Crosley Manufacturing Company, largest manufacturers of radio apparatus in the Middle West, announces that he has acquired the entire capital stock of the Precision Equipment Company, 2437 Gilbert avenue, Walnut Hills. It is the first financial deal of any magnitude in Ohio in which the principals are engaged in the manufacture of wireless telephony apparatus.

This announcement is of interest to the more than 15,000 persons residing in Greater Cincinnati who are owners of radio-receiving apparatus, and of more than passing interest to the millions throughout the United States who possess these sets.

WMH, the broadcasting station of the Precision Equipment Company will be closed so far as the broadcasting of concerts is concerned, and hereafter the nights formerly used by that company will be used by the Crosley Company, which operates Station WLW.

Homcharger Book

The Automatic Electrical Devices Company, 120 West Third Street, Cincinnati, Ohio, manufacturers of the Homcharger has recently issued a revised instruction book, which will prove quite valuable to any radio fan, whether he is using the Homcharger or not.

This booklet, besides the simple directions for operating the Homcharger, contains a paragraph devoted entirely to Storage Battery Maintenance. The information contained in this chapter will enable the radio fan to obtain the best service from his battery at minimum expense.

This booklet has been mailed by the publishers to all Homcharger users. Copies may be secured by any one interested for ten cents to cover cost of postage.

Radion Panels

The manufacturers of the well known radion panels and parts for radio use have just announced that further improvements have been made in the composition of radion which produces an even better grade of material from the standpoint of its electrical and mechanical advantages. This improved product will be known, henceforth, as resiston-radion—resiston being the trademark adopted and registered by the American Hard Rubber Company, for sheet or moulded material compounded for electrical insulating purposes, including radio apparatus.

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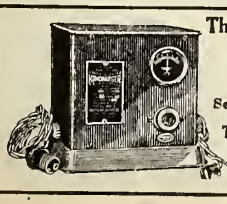

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Broadcast by Birds

Letters to the number of 100 came to The Detroit News Broadcasting Station, WWJ, applauding the recent debut of six canaries which sang recently over the radio for that station. The letters all ask: "How did you do it?"

The time for each concert is of course limited. The time allotted to each entertainer averages five or ten minutes. So it was necessary that each bird should be sure to sing when his turn came on the bill.

Canaries are temperamental like other artists. Canaries sing when they are in the mood—not when you are.

"How were you able to make them sing in the WWJ studio when you were ready to broadcast?" is the question asked by most of the listeners.

The six little feathered foreigners all of which emigrated from Germany a few months ago were brought from a bird store to the studio in the afternoon of the day they were billed to sing. This, so they would become accustomed to these unusual surroundings.

When it was time to broadcast a microphone was placed near the group of six little cages. The cages themselves were not moved. Two of the birds had been selected as leaders, and their cages were placed in the midst of the other cages so that the leaders would have feathered friends on either side—so that they would be encouraged to sing, and thus lead others to sing.

A special microphone, using a single button of carbon, was rigged up for this broadcasting. This is more sensitive than the usual type of microphone and it picked up the soft, delicate throat tones of the especially trained rollers, as well as the stronger mouth tones of the warblers.

When the program director was ready for the canaries to sing, they were a bit shy. Then one of the artists began to play a few bars of piano music softly. That started them. One of the operators turned on his apparatus, and when the switch was opened, the birds began to sing.

The song of the birds transmitted clearly, and were heard by many listeners as the 100 letters of approval indicate. These letters came from nearly all parts of the continent.

The canaries singing in Detroit, proved interesting to a cat in Ann Arbor, Michigan, as related by a postal card from that city. It was signed "Your Ann Arbor Audience," and said: "We heard every trill of the canaries as clearly as though they were in the room with us. It was lovely. Our little gray cat sat up and took notice!"

This broadcasting also started impromptu concerts in homes where there were other canary birds. G. E. Deuble, 19, 340 Frazier Drive, Cleveland, Ohio, wrote as follows: "We have a canary bird, whose cage is in the room with our radio receiving set. This bird was a Christmas gift to my wife. We didn't know it could sing until the canaries at Station WWJ began. Our bird looked into the loud-speaking horn, twisted his head from side to side, and then started to sing himself."

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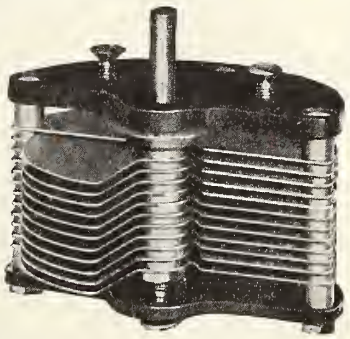

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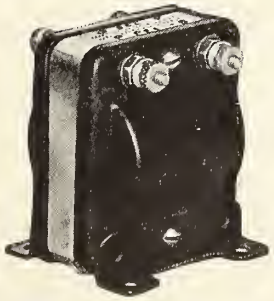

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How to Tune Receiving Sets

By A. T. VAN DYCK
Radio Engineer of General Electric Company

The basic rule to be followed for best results in the tuning of a radio receiver is to understand what each control does, in a general way at least, and to use the controls in systematic and not haphazard manner.

It is not necessary to know the theory of gas engines to operate an automobile, but the driver must know at least what the function of each control is, to drive intelligently, and the more he knows the better he is able to drive. So with the radio receiver, an understanding of the general principles of the set and its controls is necessary in order to obtain good results consistently.

In order not to digress from the immediate subject of tuning, I shall have to assume certain things. First, that your apparatus is some good standard make, or if homemade is constructed and connected in one of the standard ways. Then I shall assume that your antenna system is properly installed—that the aerial is sufficiently high, not too long or too short, is well insulated and as clear of surrounding buildings and trees as possible; that the ground connection is a good one, and that all electrical joints in the aerial and ground wires are soldered.

What Tuning Means.

Tuning, in the meaning of this article, is the process of adjustment of receiving apparatus to accord with a particular transmitting station, in order to obtain the greatest response to that station's waves. A radio transmitting station sends electric magnetic waves out through space in all directions. When a wire is elevated above the surface of the earth it is struck by the passing radio waves. Radio waves are really moving electric forces, just as waves in water are moving mechanical forces, and when they strike a wire they cause it to move, electrically.

The tuning of the aerial is for the simple purpose of so adjusting the aerial wire that it can vibrate electrically to the greatest extent possible.

An important thing to note about these travelling radio waves is that they have definite frequency, or in other words, a certain number of them pass the receiving aerial in a second. The exact number is determined by the adjustment of the transmitter. Since these waves travel at a certain speed, they must be a certain distance apart, which is called the wave length. So that, instead of saying that a station sends out waves 360 meters apart, we could just as well, perhaps more clearly, say that it sends out 830,000 waves a second.

These waves strike receiving aerials regularly and evenly one after another, and we want to have them vibrate the aerials as much as possible.

To do this we adjust the electrical length of the antenna to suit the frequency of the waves. Then the antenna will swing electrically as far as it can, depending upon the strength of the wave pushes.

Therefore, in radio receiving sets, changing the electrical length of the antenna is done easily by putting in the circuit some wire wound up into a coil, with some means provided for changing the number of turns used—for example, by a switch, or with some means for varying the electrical effect of the turns without actually changing the number of them.

Changes Wave Length.

Also it is found that if there are connected in the circuit two metal plates, which are placed near to each other, but not touching, and one of them is moved, this changes the electrical length of the circuit. Such a device is called a variable condenser.

There are two somewhat different ways of connecting up the tuning devices which are in common use today. These are known as the single circuit tuner and the two circuit tuner. In the operation of a receiver based on either system adjustment of the tuner part is but half the problem. In addition, there is the detector, which is connected to the tuning part, and which changes the received high frequency current into one with a form which will operate telephone receivers. There are two kinds of detectors in common use today—the crystal, or mineral, detector and the vacuum tube detector.

How to Operate.

The single circuit crystal receiver is of course the simplest to operate. In this there are only the tuning control and the crystal. The proper procedure in tuning this type is to set the detector in contact and slowly vary the tuning control until desired signals are heard, then adjust tuning and detector contact to maximum results.

It is very desirable to connect up a doorbell buzzer, a push button and a single dry cell battery so as to test the detector and set it in sensitive condition.

In the operation of detector vacuum tubes the adjustment the tube to sensitive condition is done on most sets entirely by the filament rheostat, which controls the current through the filament, and therefore its temperature. Usually the tube will operate to some degree if the filament temperature is anywhere near right, but best signals will be obtained only after it is exactly right, which is accomplished after signals have been picked up. The filament must not be burned brighter than necessary.

Most sets using vacuum tube detectors have another feature added in connection with the tuner called regeneration which is valuable because it adds enormously to the sensitiveness of the set. It consists usually of a coil whose electrical relation to the tuning coil can be adjusted. This coil is called the tickler coil, or the intensity coil, or the regeneration coil. When this is provided on a receiver it gives one more adjustment to be made.

Consider a single circuit receiver using vacuum tube and regeneration. We have these controls, the wave length tuning, the regenerative coil, and the filament rheostat. Set the filament to as near proper brilliancy as it is possible to estimate.

How to Adjust Controls.

The next step is to vary the wave length control over its range very slowly, listening carefully for the desired signals. When they are heard adjust the wave length control and the filament control to best results and then increase the regenerative or tickler control until signals are best, possibly slightly readjusting the wave length control, which may be affected by the change of the tickler.

The two circuit receiver, especially if provided with regeneration, is much more difficult to adjust. The major controls on a two circuit receiver are the aerial circuit—called primary—tuning, the secondary circuit tuning, the coupling between these two, the tickler, and the tube filament rheostat. In short, there are five controls to adjust. The most important and most critical one of these is the secondary tuning.

To pick up signals, set the coupling at or near maximum, the detector filament brilliancy properly, the primary tuning control at or near its lowest value, and the tickler at or near its lowest value. Then very slowly vary the secondary wave length control from zero to maximum. If signals are not heard, change the primary setting five or ten degrees and vary the secondary through its range again. This should be continued until signals are heard. If they are not heard increase the tickler some and repeat.

Hook-up Ideas Are Worth $1

EACH radio fan who experiments finds something about design or operation that will help his fellow fan. Send in your new hook-ups and other original devices, accompanied by clearly drawn diagrams. Radio Age will pay $1 for all such original articles and drawings used. Text should be limited to about two hundred words.

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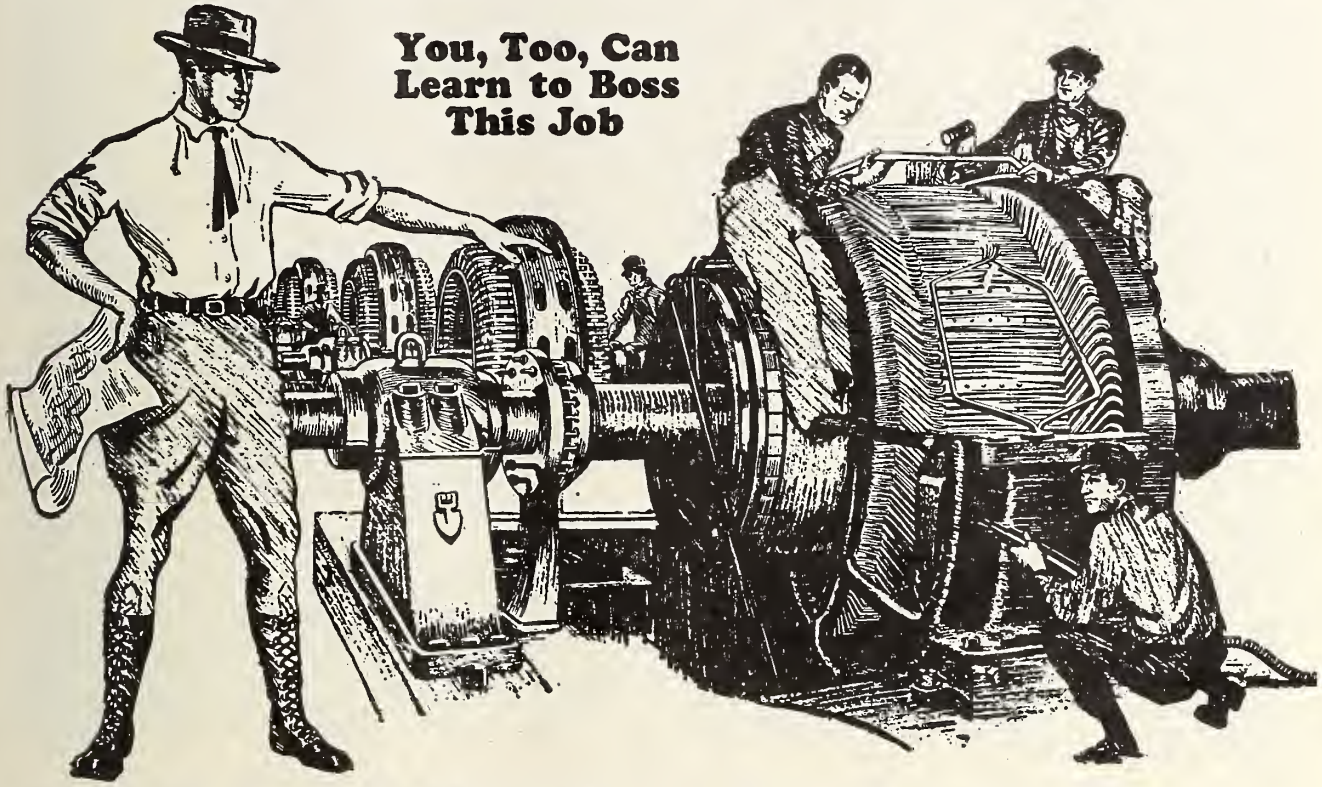

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Tribute to Harbord

Following is a statement issued by Secretary Weeks, of the War Department, on the amendment to the army bill adopted by the House of Representatives for the purpose of depriving General Harbord of retired pay:

"It is most regrettable from the standpoint of the War Department and the public service that the House of Representatives adopted an amendment to the Army Bill which, in effect, takes from General Harbord, until recently Deputy Chief of Staff, his retired pay because he has become president of the Radio Corporation of America. The reason given for this action is that he has been employed by the company for the purpose of obtaining more business from the Government than the company could otherwise hope to secure. This is an insult to General Harbord and to the Government itself.

"For nearly forty years General Harbord has been faithfully and efficiently serving the Government and, regardless of what position he may occupy in civil life, the best interests of his Government will be his chief concern. Any inference to the contrary reflects on the person making it. As a matter of fact, the Government's business with the Radio Corporation is inconsequential. At the present time we have no contract with it, and, generally speaking, purchases of radio equipment, which are of small moment in total amount, are made from the manufacturers. But there is a much broader question involved in the action taken by the House.

"General Harbord, the son of a Western farmer, enlisted in the Army, starting his military career as a private at the beginning of the World War, at the age of fifty, he held the rank of Major. While his rank was not high, he had already impressed himself upon the War Department and his associates in the Army to such a degree that he was made Chief of Staff of the American Expeditionary Forces. He went from that position to the command of the Second Division, one of the most conspicuous fighting divisions in the Army. He commanded this division during the Marne-Vesle campaign.

"Things were not going satisfactorily in the Service of Supply and he was transferred, greatly to his regret, to the head of that service, a position of enormous responsibility and of the greatest importance to the Army. He so reorganized and conducted that service that he brought to himself not only the plaudits of his associates in the Army, but attracted the attention of men of importance in civilian life who were temporarily serving the Government in Europe; in fact, so extraordinary were his services and organizing ability that they have occasioned continual commendation from civilians since the war, and it was because of this capacity that he was called to the presidency of the Radio Corporation, as the most competent available man for that particular service in the United States.

"The development of the radio is of vast public importance and there is, therefore, a public reason why he should accept and fill that position, retaining his place on the retired list of the Army so that he would be available for service in an emergency. If a British officer, French officer, or an officer of any other nation had performed for his government the service rendered by General Harbord, instead of having this stigma attached to him, the inference that he is dishonest—not to mention taking away his retired pay—he would have been given honors of very important character and certainly in the case of Great Britain, a large honorarium as well. I do not believe the people of this country wish its great defenders treated in such a shameful way, and I should think General Harbord would feel that a country that would tamely submit to such treatment of one of its officers was hardly worth serving. He will certainly feel a sense of injustice which time can never efface."

As amended, the Army appropriation bill provides that no officer, retired or in active service, employed by an organization doing business with the Government shall receive any of the funds carried. General Harbord, as well as many officers in similar circumstances, would receive no retired pay.

A study of the business conducted between the Signal Corps and the Radio Corporation reveals the fact that scarcely any business has been transacted for several months. Since the war it was not more than $300,000 worth, when this organization was the only bidder. Today, however, the Signal Corps deals directly with the General Electrical, Westinghouse and other manufacturing companies, although the Corporation reserves the right to bid. During the calendar year the Signal Corps purchased electrical equipment valued at $1,475,000, of which about fifty per cent was radio apparatus.

QUESTIONS

FOR those who miss the usual page of questions and answers in this issue of Radio Age the explanation is made that it is left out this month for two reasons, lack of space and the fact that answers to queries have been forwarded by direct mail. The questions and answers will be resumed in the next number. Meanwhile send in your questions and they will be answered as usual by Frank D. Pearne, technical editor of Radio Age. Enclose stamped and self-addressed envelope with your communications.

Open Eastern Office

The United Manufacturing & Distributing company, manufacturers of the well-known United Condensers and transformers, announce that they have opened an eastern office at 50 Church Street, New York City, in charge of Arthur Deery.

Radio vs. Crime

By Washington Radio News Service.

Attorney-General Daugherty plans a National Bureau of Identification and Information in Washington, and radio will be the means of broadcasting data on criminals and their activities to the whole country, according to William J. Burns, Chief of the Bureau of Investigation. This National Gallery of Rogues and Crime, the idea of the Attorney-General's, is believed to be something unique in criminal investigation as it will cover the whole country and be immediately available.

"In these days of preventative medicine, and fire and accident prevention," said Mr. Burns, America's foremost detective, "we have now come to crime prevention. We plan eventually to have on file here photographs, finger prints, descriptions and histories of every known criminal in America, as well as data on his methods of operation," he explained. When legislation authorizes it and the system gets into operation with state, county and municipal police departments cooperating, Mr. Burns believes we will have made the first practical step toward the prevention of crime and the apprehension of criminals.

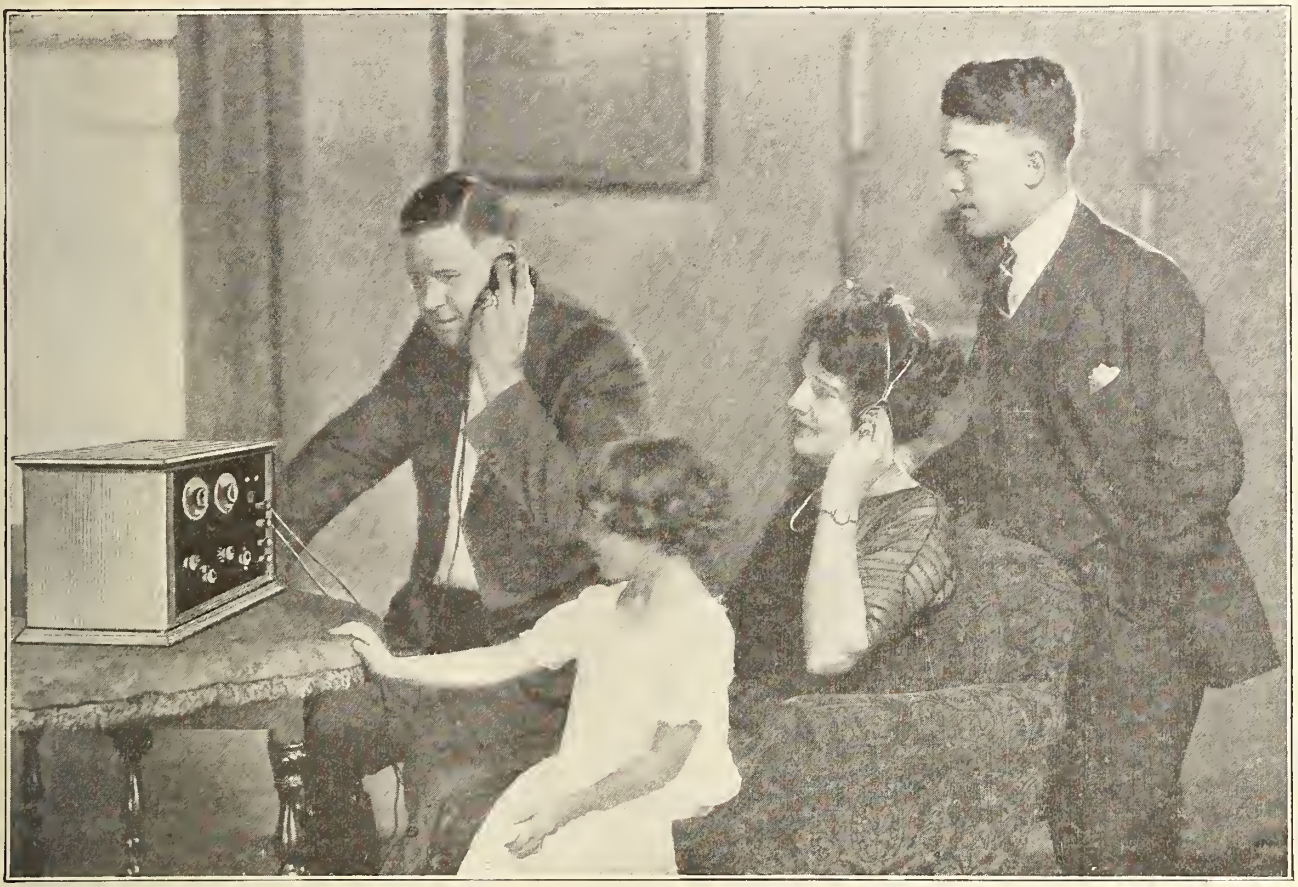
If a local police department radios to Washington the details of a crime, together with a description and name of the suspect, or asks for data on a man in the rogues' gallery, it would be disconcerting for the fugitive from justice to know that a few minutes later, his whole history would be broadcasted throughout the United States.

He would be watched for at every possible point of departure within an hour after the commission of the crime. Mr. Burns believes this would restrain, to a great extent, the activity of criminals.

Already one police association has voted to turn over its criminal historical data to the Washington National Headquarters, where the government records will soon be moved from Leavenworth, Kansas, as a nucleus of the criminal and rogues' archives, to be kept by the new division under Mr. Burns. Cooperation of all the states is anticipated as well as of all large cities, where radio broadcasting is rapidly coming into use.

A national bureau of identification will be of immense value to the country, Mr. Burns said, explaining that criminal psychology was such that when he is known, he is practically out of the game. "Turn the light on him, and he is destroyed," Mr. Burns put it. "Catch him, without his knowing how it was accomplished," he said, "he becomes uneasy and is thereafter slow to take a chance." Sir Basil Thomson, formerly head of Scotland Yard and a recent visitor in Washington, was most interested in the Department's scheme, Mr. Burns said. Sir Basil is also a firm believer in the value of radio in general police work.

Send $1.00 to Radio Age, 64 Randolph Street, Chicago, and receive this middle-west radio periodical for six months. Regular subscription price is $2.50 a year.



"SENSITONE" Regenerative Radio Receiving Set

$15

DOWN AND $10.00 PER MONTH

Immediate Shipment

Manufactured under Armstrong License, U. S. patent No. 1,113,149 and pending letters of patent No. 807,388

READ THESE TESTIMONIALS!

Seaton, Ills., December 22 1922.

Harold R. Waken Co
Chicago, Ills.

Dear Sirs:

Following is a report of the different stations I received on the Sensitone Detector, and all came in very clear, on the 21st.

Ft. Worth, Texas	Memphis, Tennessee.
Davenport, Iowa	Dallas, Texas.
Cincinnati, Ohio	St. Louis, Mo.
Indianapolis, Ind	Louisville, Ky.
Pittsburg, Pa.	Schenectady, N. Y.
Kansas City, Mo.	Denver, Colo.
Chicago, Ills	Newark, N. Y
Atlanta, Ga.	Detroit, Mich.

Minneapolis, Minn.

I did not go to bed until 3 a. m. next morning Certainly is a fine machine. Hope to add Amplifiers and Loud Speaker in near future. I am getting stations that other radio bugs here in town don't get. 12 radio sets in town at present. 400 population, and lots of bugs here. You can use my name if you choose

Yours truly,

D E. HAIST,
Telegrapher, M. & S. T. L. R. R. Seaton, Ills.

Harold R. Wakem and Co.,
Chicago.

Dear Sirs:

Last night was the first night that I tried my Sensitone, and here are some of the stations that I heard very well: Houston, Texas; Denton, Texas; Fort Worth, Texas, St. Louis; Dallas News; Cincinnati; Atlanta Journal; Detroit News.

I heard ever so many others, that I just tuned in or cut as they interested me or not. Now, don't you think that's a good start for a green beginner? According to what I have read I am living in the "home" of static and I am sure there was lots of it yesterday, as it was very warm, and we had a lighting storm also.

I listened in to the St. Louis Post-Dispatch for over an hour, as the r concert was fine, and everything was clear. Yesterday afternoon at three I heard Houston, Tex., very well.

Detroit is a mighty long distance from here, so I consider your set a marvel.

With all good wishes for the coming season I beg to remain Yours sincerely,

REV. JOS. J. BOUDREAUX.

December 13, 1922, 9:49 p. m.
DB 841, 49 Collect NL,, Lubbock Tex 13
Harold R. Wakem & Co., Chicago, Ill.

In answering queries relative distance performance be explicit without fear quote this telegram first night's program included Detroit News, Drake Hotel, Chicago, Kansas City, Davenport, Atlanta, Paducah, Ky., Los Angeles, San Antonio, Houston, Ft. Worth, Oklahoma City, entire cotton, cattle, hog, sheep markets from Kansas City. Two p. m.: Is more than satisfactory with thirty foot aerial. W. H. WARD. Theriot, Louisiana, December 16, 1922.

ONLY 500 SETS SOLD ON THE EASY-PAY PLAN

We are making this rather costly investment in order to get 500 sets in the hands of that number of influential families, so that, when we put our goods in the hands of dealers, they may have enthusiastic SENSITONE boosters nearby to whom they can refer their future prospective buyers.

Fill out the coupon, attach check or money order for $15.00. Set will be shipped at once by express. Those who delay will be too late.

Harold R. Wakem & Co.
900 Washington Blvd. CHICAGO

HAROLD R. WAKEM & CO.,
900 W. Washington Blvd., Chicago, Ill.

Enclosed you will find $15.00 as first payment, upon receipt of which you will send me your complete Sensitone Radio Receiving Set, as described above After I have used the set for thirty days, I agree to send you $10 00 and the same amount every thirty days thereafter, until the full purchase price of $95 is paid. This set is to remain the property of Harold R Wakem & Co. until payments are completed.

Signed.....

Street address.....

City.....

In the spaces below give the names of two references, (banks or business houses preferred)

Name and Address.....

Name and Address.....

Reinartz Radio

How to make this distance wrecker.
How to amplify it.
How to make a Reinartz panel.

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Written and Illustrated by
FRANK D. PEARNE
Chief Instructor in electricity at Lane Technical High School, Chicago, and famous writer on radio construction and operation.

Hook-up for the Long Distance Crystal Set—They are all trying it.

Other articles on latest radio angles fully illustrated.

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AT YOUR NEWSDEALERS' OR SEND MONEY ORDER OR CURRENCY TO PUBLISHER

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REINARTZ STILL REIGNS—SEE BACK COVER

RADIO AGE

The Magazine of the Hour

Price 25 cents

April, 1923

IN THIS NUMBER

The Kopprasch Circuit—A Hair Raiser

How to Make a One-Tube Loop Aerial Set

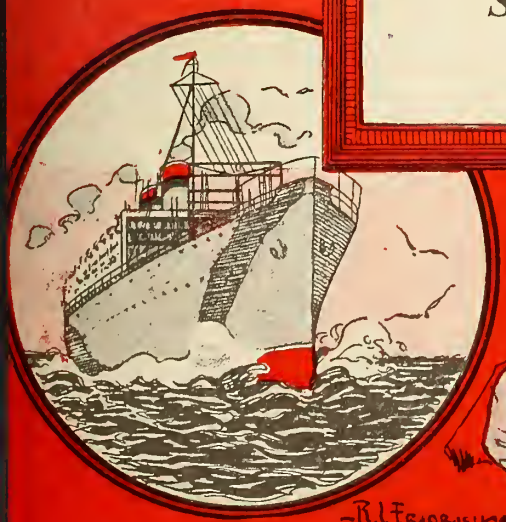
(*Uses dry battery—Eats up Summer Static*)

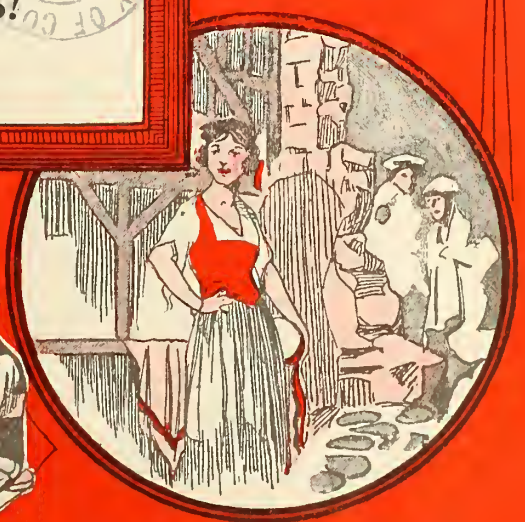
New Relay Plan for Broadcasting

A Two-Circuit Crystal Set

Complete List of Broadcasting Stations

SEE THE HOOK-UPS!





PRESS OF CO. NOV 4

OFFICIAL NEWS MEDIUM FOR NATIONAL BROADCASTERS' LEAGUE

As Long as You're Listening In

Get It *All*—RIGHT!

Do you know that the **effect** produced by the finest Radio Receiving Set you can buy, can be **ruined** by an inefficient head-phone or loud speaker equipment?

You must have purity and clearness of reproduction.

If musical or vocal tones are brought in distorted you cannot fully enjoy your radio.

The Atlas Loud Speaker Cannot Be Excelled For Pure, Sweet, Undistorted Tone

Here indeed is the loud speaker deluxe—the **one** speaker that you can KNOW is giving you the finest results that can be **brought in** by your receiving set.

There are many loud speakers on the market. But comparative tests of the most searching and exhaustive nature, have proved beyond question that in purity of tone the Atlas Loud Speaker **leads them all.**

You can notice the **difference** instantly. With the Atlas all the distortion, all the confusing metallic echo, all the distracting mechanical sound is **gone**—absolutely done away with by the patented construction of the **double composition** diaphragm found **only in** the Atlas. What you hear is a reproduction of life-like tone and **distinctness.**

With the Atlas, you do **not** need the extra battery, extra tubes and other costly equipment usually required. Can be used with power if desired.

This is only one example of the **conspicuous excellence** found in all Blairco Radio.

See Your *BlaircO* Dealer Today

Blairco Service, dispensed through leading Radio Dealers, enables you to take full advantage of the greater care, better materials and more scientific engineering built into all radio accessories and equipment sold under the Blairco triangular mark of **super-quality.** It enables you to enjoy radio **at its best**—and at no additional **cost.**

If you need additional equipment—if you want to know the cost of a complete Tube or Crystal Receiving Set, including everything from Aerial to head phones, see your local Blairco dealer. Get a free estimate on the complete job. If you have no local Blairco dealer, Write Us Now for Folder and Prices.

Radio Dealers! Blairco Products are piling up sales and satisfied customers for Radio Dealers, wherever sold. An unbeatable opportunity for you, if your territory is still open. Big advertising campaign. Live sales helps. Liberal proposition. Write for it QUICK.

Mitchell Blair Co.

"First With the Best"

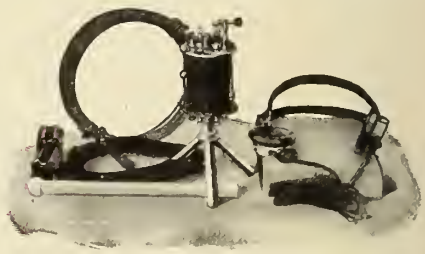
1429 So. Michigan Ave., Chicago, Ill.

Buy at the Radio Store where they display this sign—"a distinguishing mark" of Mitchell Blair Company Proven Products.

Atlas Loud Speaker

Will not blast no matter how much current is passed through it. Entirely eliminates tone distortion and mechanical noises. No loud speaker equals it in the pure, clear and exquisite tones brought in. Satisfaction guaranteed or money back.

Price, complete, with sound reflecting base and horn attachment with cord—F.O.B. Chicago $25.



BlaircO "FOUR" Crystal Set

The most sensational receiving set value ever offered. All nickel steel. Stands 9 inches high. Takes four sets of head phones. Brings in tones of remarkable clearness and purity. Price only $7.50. Complete with Aerial, ground wire and Atlas head phone—$20.00.

Atlas Head Phones

Only high grade receiver set offered at a reasonable price. 2200 ohms. Sensitiveness and adaptability superior to all others. Eliminates disagreeable noises in ears. Comfortable. 5-ft. of cord. Price—$9.00.

RADIO AGE

The Magazine of the Hour

Volume 2 *APRIL, 1923* *Number 3*

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Saying "No" to an Advertiser

IT IS a pleasure to have a genuine high class radio article exploited in our advertising columns. It would be far from a pleasure to learn that we had permitted the advertisement of equipment that was manufactured for sale and not for use. Magazines, like men, are known by the company they keep.

Sometimes it is necessary to reject an advertising contract proffered by a manufacturer or dealer who is a bootlegger at heart. He puts a lovely label on his goods but the goods are poison.

This magazine wants advertisers. It wants a lot of advertisers. But it is not likely to sell out its great family of readers and their generous support. It, therefore, has been necessary to reject some advertising business. But in the long run we shall have all the more advertising by thus playing fair with our readers.

In that connection let us say that we know a lot about the goods that are advertised in Radio Age. We know personally. We vouch for them.

The products of the United Manufacturing & Distributing Co. are standard. This company's transformers and condensers have been advertised in our columns for a year and the approving verdict has been unanimous.

We KNOW that the Million Point Mineral Crystal is far and away better than the average crystal. We knew this before our readers began to tell us about them.

We KNOW that the Sensitone receiving set is a corker. We have tested one for months with but one result—successful reception. This outfit eats up distance and brings in the nearer stations like a glorified Victrola.

We KNOW that Mr. Pfanstiehl of the Pfanstiehl Radio Service Co. is a distinguished radio research man of high standing among radio engineers and when he offers inductance coils he is offering 100 per cent coils.

We are proud to have the company of the Rauland Manufacturing Co. of Chicago and the Franklin Institute of Rochester, N. Y., and the Chicago Engineering Works and of the Mitchell Blair Company of Chicago and any and all other good concerns which are OR WILL BE represented in the advertising columns of this magazine.

Does this policy pay?

Well, our circulation doubled in March and we have just started.

—The Editor.

KOPPRASCH CIRCUIT FOR W-D-11 TUBES.

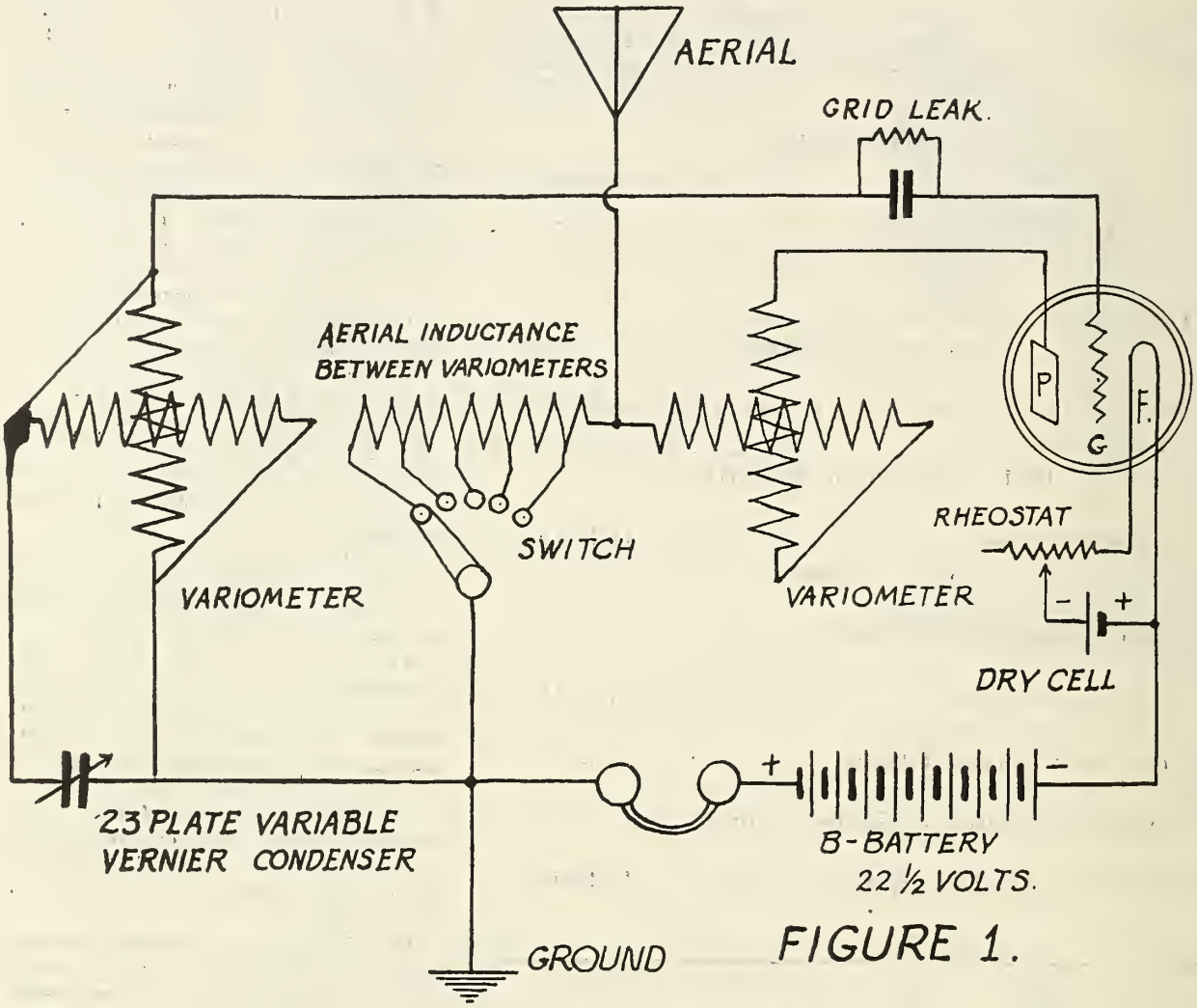


FIGURE 1.

MOUNTING OF VARIOMETERS AND TUBE

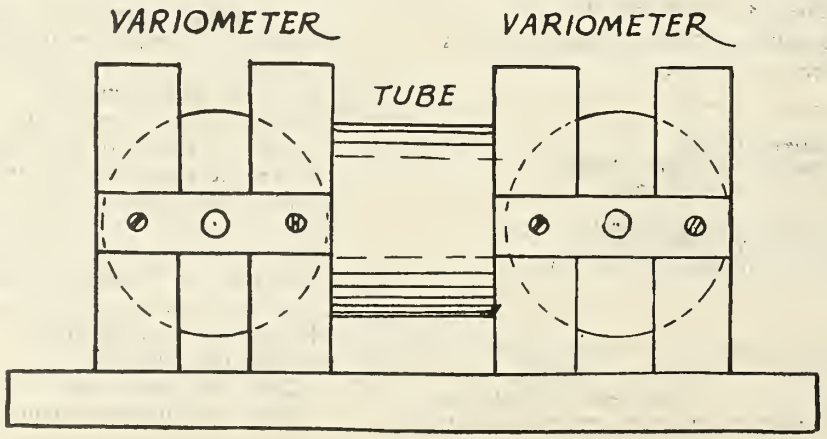


FIGURE 2.

RADIO AGE
"The Magazine of the Hour"
M. B. SMITH, PUBLISHER
PUBLISHED MONTHLY GARRICK BLD'G CHGO.
FREDERICK SMITH, EDITOR

The Kopprasch Circuit for Local and Long Distance Work

By F. D. PEARNE

ONE of the cleverest circuits, which has appeared lately, is the new Kopprasch arrangement, which makes use of two variometers with the aerial coil placed in inductive relation with both. This set was designed by Mr. A. H. Kopprasch of Chicago, who spent many months experimenting before he succeeded in getting the results which he sought for.

The strength of the signals obtained when using W-D-11 tubes in this circuit is much greater than those of the other standard circuits and when the 6-volt tubes are used the volume is still more pronounced.

One of the best features of a set of this type is the fact that no tube noises of any kind are noticed, once the set is adjusted and the music comes in, very clear and distinct. Stations KGW, Portland, Oregon, and KHJ, of Los Angeles, California, have been clearly and distinctly heard in Chicago with a Kopprasch circuit, using one W-D-11 tube. These stations were not only heard, but were held as long as desired without the usual fading away which is so common with reception at such great distances.

Figure 1 shows the arrangement of the circuit, which is quite simple and easy to construct. The outstanding feature is the peculiar arrangement of the variometers, one of which is connected in parallel and the other in series. The aerial inductance is wound on a paper tube which is placed between the variometers and in inductive relation to them.

Figure 2 shows how this is accomplished. The tube is made of any heavy cardboard tube, 1 5-8 inches long and of sufficient diameter to allow the rotors of both variometers to clear it. 40 turns of No. 22 cotton covered magnet wire is first wound on the tube, taps being taken off at the completion of the eighth turn and each following eighth turn. These taps are connected to the switch points as shown. This coil should be wound in the opposite direction to the winding of the stators of the variometers. The starting end of the winding is connected to the series variometer shown on the right, with the aerial connected to the junction between them.

The variometer on the left is connected in parallel, that is, one end of the rotor winding is connected to one end of the stator, and the other end of the rotor is connected to the other end of the stator and the connections to the circuit are made to the junctions so formed. A 23 Vernier, variable condenser is connected across the terminals of this variometer, one terminal of which makes contact with the ground, switch and head phones.

The rest of the apparatus used is all standard. The grid leak is of the ordinary pencil type and the grid condenser is of the ordinary .00025 fixed type. The battery used for the filament supply will be determined by the kind of tube used. For the W-D-11, one cell of dry battery will suffice, but if a Radiotron, or Cunningham tube is desired, the current should be supplied by a six-volt storage battery. A 22 1-2 volt "B" battery should be used to energize the plate circuit no matter which kind of a tube is used.

The head phones may be of any standard make having from 2,000 to 3,000 ohms of resistance. In mounting the variometers and tube, it is a good plan to fasten them securely to a wooden base, in such a way that the tube can be forced tightly between them. If this can not be done, then the tube may be supported by means of sealing wax applied to the sides of the variometers.

Most all the causes for trouble in this set are found in one of two places. Either the winding on the tube is in the wrong direction, or the grid leak resistance is not correct. By carefully examining the stators, it is easy to find the direction of winding and when the two variometers are placed side by side, these windings should appear to be a continuation of winding in the same

Answered

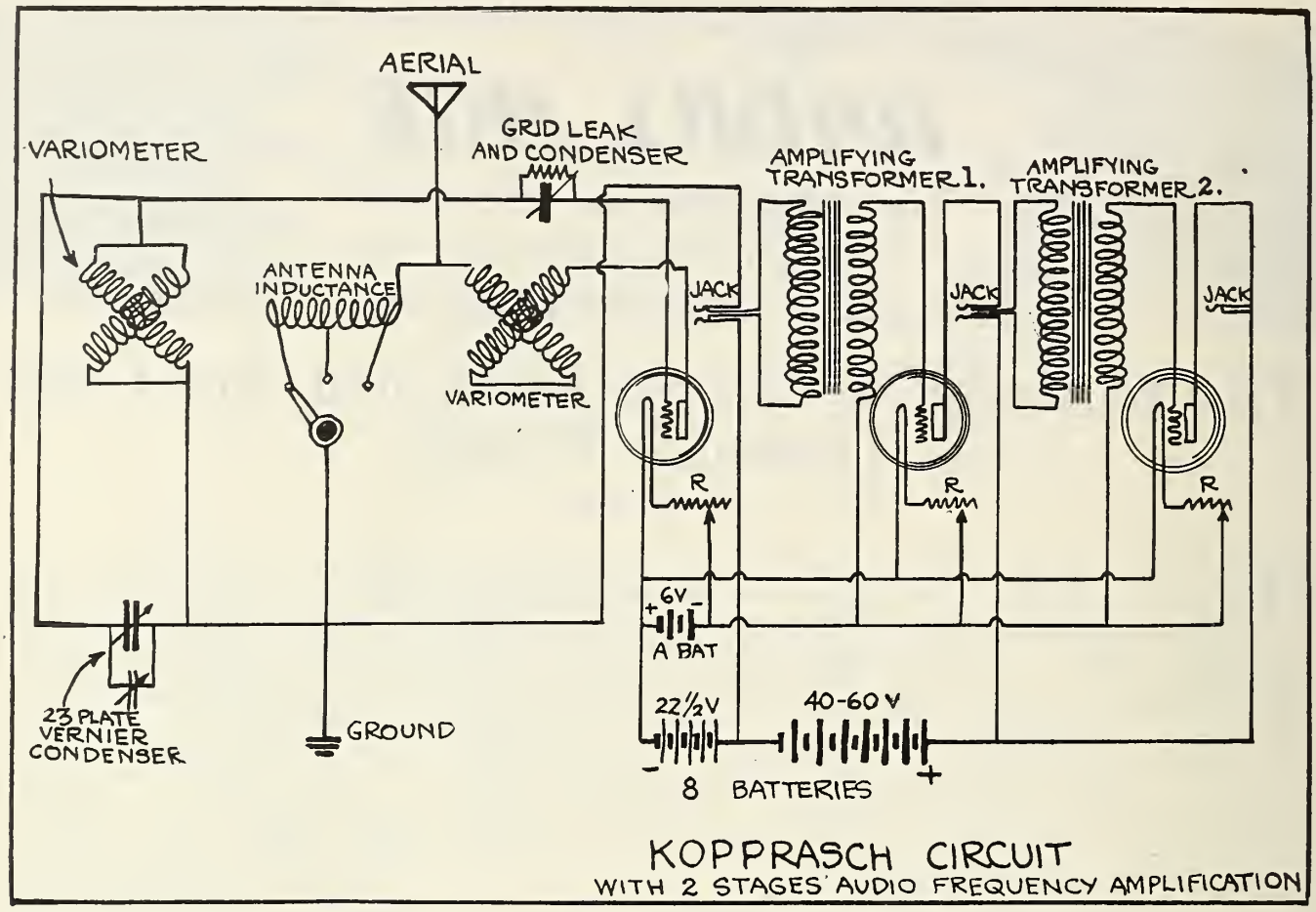
By Raymond E. Miller

THE glow from the tubes illuminating the walls in fantastic patches of light and dark, the thrilling growling and squealing from the loud-speaker, making the room resound with exotic sound. The faces eager with anticipation, half in shadow would make a fitting etching for Gustave Dore.

A melodious Southern voice, vibrant, rich in feeling, sings a ballad which has an exquisite appeal. A slight turn of the little dial mounted in the face of the cabinet brings another station from out of the air; a piano solo is being rendered from the subtle fingers of a master; there is no contact with grim realities, only the delicate music. One drinks it in with great relief, free from the distracting influences of the concert hall.

Station after station is tuned in at one's pleasure, opera, speeches, songs, great symphony orchestras, the light music of Terpischore. Space is annihilated.

God has answered, not only for Job the great question that he asked, "Who shall make the lightning go and say, 'I am here'?" but He has answered all of us.



KOPPRASCH CIRCUIT
WITH 2 STAGES AUDIO FREQUENCY AMPLIFICATION

direction, then they are separated and the coil forced in between them. As stated before this coil is wound in the opposite direction. The other case of trouble which may occur is a beat noise in the phones. This may sound like a hum or a series of slow pulsations and is caused by too high resistance of the grid leak. This may be corrected by increasing the size of the lead pencil mark which forms the leak. It should be done carefully and with a very sharp pencil. Once this is right no further trouble will be noticed.

Deaf Hear Radio

London, England, reports that a 77-year-old man, deaf for thirty years, listened successfully to a radio concert at a friend's home. In a series of experiments at Marconi House Harry Shwer, aged 13, deaf from birth, heard music and the human voice for the first time in his life. It was found he could hear through one ear, but not the other.

Two of his companions from a deaf institution were tested. One heard a fox trot, but the other could hear nothing.

This Is the Life

The greatest American steamship, Leviathan, which has been refurnished and rehabilitated by the United States government at a cost of $8,000,000, has radio equipment connected with private telephones in each of the private rooms. Passengers may talk to their friends ashore without leaving their state-rooms.

Amplifying the Kopprasch

THOSE interested in amplification of the Kopprasch circuit will find the method clearly pointed out in the cut. Excellent results may be obtained from audio frequency transformers having ratios of ten to one and five to one.

If WD-II tubes are used the extra tubes will require a filament current of .5 amperes added to the .25 ampere used by the detector. The filament battery, therefore, should consist of three dry cells connected in parallel, that is all of the carbon terminals connected together and to one side of the filament and all of the zinc, or negative terminals connected together and to the rheostats.

Care should be taken lest these cells be connected in series as such an arrangement would burn out all the filaments.

Reprinted by courtesy of the Chicago Herald and Examiner.

Radio Exports Fall Off

Radio exports shipped out of the country in December totaled $163,236 in value, less than the total for November which was $223,180. The decrease is explained by officials of the Department of Commerce as due to large shipments of apparatus to Argentine in November. In December, Canada took the largest amount valued at $74,344.

Total exports of radio apparatus for 1922 amounted to $2,897,799 being more than a thirtieth of the total electrical exports for the year, which amounted to over $63,000,000. In 1921 radio exports were not separated from line telegraph and telephone apparatus so no comparison for the two years can be shown.

The Westinghouse Electric & Manufacturing Company on February 26 filed a suit in the District Court of New Jersey against the Radiocraft Company, Inc., and the DeForest Radio Telephone and Telegraph Company for infringement of the Armstrong patent.

The Westinghouse Company, one of the five organizations in the Radio Corporation, claims that the Armstrong license, one of which is held by the Radiocraft Company, a subsidiary of DeForest, does not permit the sale of Armstrong circuit sets through the regular trade channels of jobbers and dealers, but only direct to the amateur. The suit evidently seeks to prevent the seventeen independent manufacturers licensed under the Armstrong patent from doing business except as mail order houses, that is, direct to the fan.

How to Make a One Tube, Loop Aerial Receiving Set

By F. D. PEARNE

A RADIO SET, using very little apparatus and operating well on a loop aerial, is something which will interest many amateurs who find it difficult to construct an outside aerial. Everybody knows that much interference can be eliminated by the use of a loop aerial and while it will be necessary to move the loop around to find the best point of reception, on account of its directional characteristics, still this slight objection, if it is an objection, is more than offset by the quiet reception obtained.

Such a set has been designed by Raymond Chassevent, who no doubt had in mind the hard-hearted landlords who seem to have so many objections to allowing an aerial to be placed on their buildings. Any way Mr. Chassevent has given us something that will help us dodge the static when summer changes the atmospheric conditions.

One of the principal claims for this set is the fact that when built according to specifications, a complete elimination of interference may be obtained when several stations are broadcasting on nearly the same wave length at the same time. The set described will operate efficiently on wave lengths between 300 and 600 meters and will cut out all interference from amateurs who are working on wave lengths below 300 meters.

The entire outfit is made up of very few parts and is quite inexpensive, is very compact and may be mounted in any way desired, so long as the parts are not crowded. A space of about 3 inches should be left between the different parts and all connections should be as short as possible.

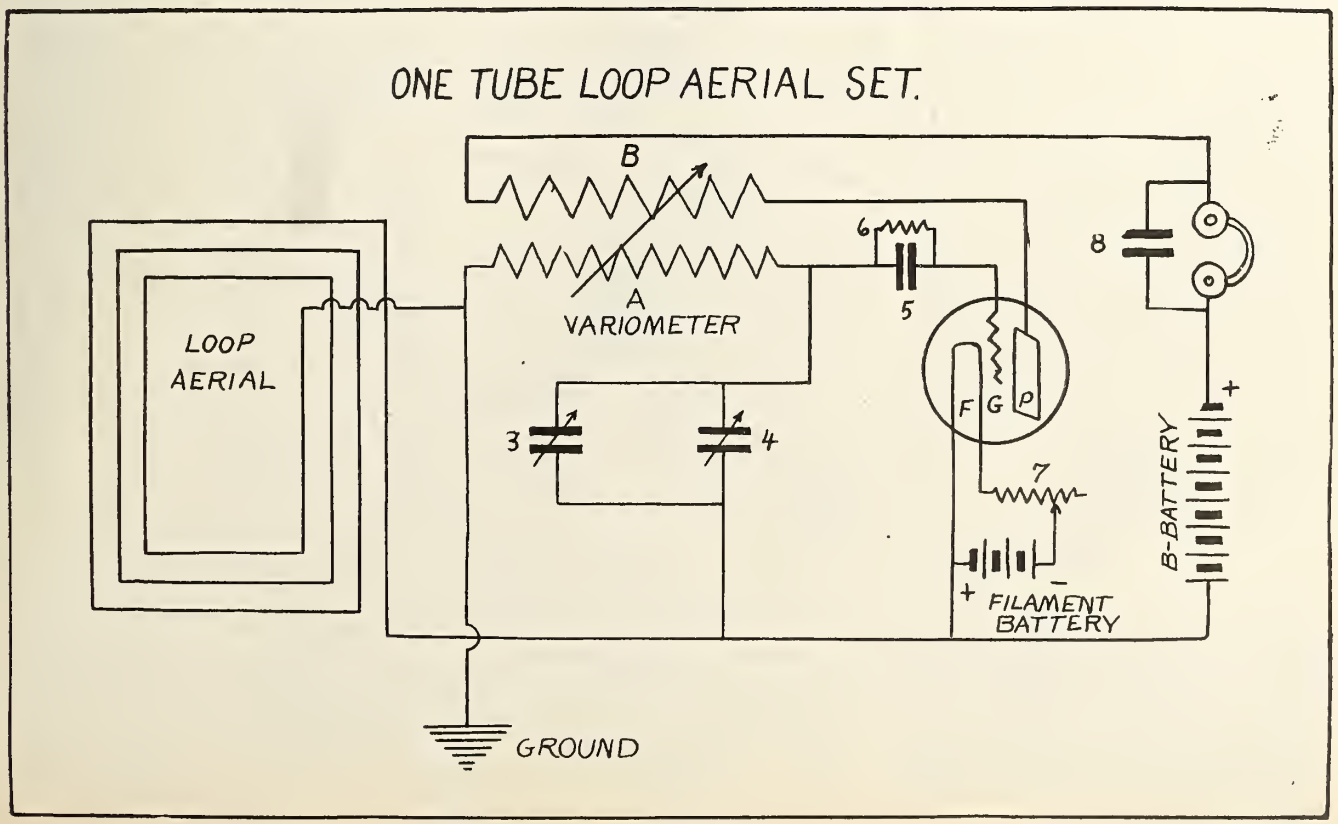
The loop aerial should be 3 feet square and wound in a vertical plane. The wire used for this purpose is No. 24 double cotton covered copper and the turns should be about one inch apart. Ten turns will be all that will be required to give the best results, although a little experimenting may help in determining just the right amount for any particular set.

The winding on the variometer shown in the drawing, consists of 40 turns on the rotor and 30 turns on the stator. When purchasing an ordinary variometer, it is usually found to be connected in series. The connection between the rotor and the stator should be broken, so that they form separate circuits. The terminals of the stator should then be brought out to 2 Fanstock clips at the back of the variometer. The two terminals of the rotor are also brought out to two clips on the back of the stator blocks.

The winding on the stator, as shown at "A" on the drawing, forms the tuning inductance and the winding on the rotor is used as a variable plate inductance. The condenser shown at "3" is an eleven plate variable, having a capacity of .00025 M. F. and "4" is a vernier arrangement which consists of a 3 plate variable condenser. This small condenser acts as a vernier adjustment for the eleven plate condenser.

The grid condensor shown at "5" can be of any capacity ranging from .00025 to .0005 M. F. and the grid leak," 6" should be of the variable type so that it may be varied to suit the characteristics of the tube used. By the careful adjustment of the grid leak, the strength of the signals may be greatly increased. The rheostat used by Mr. Chassevent and shown at "7" on the drawing is a Bradleystat. Any of the standard

(*Continued on page 10.*)



Construction and Operation of a Two-Circuit Radio Receiving Equipment with Crystal Detector

(By the U. S. Bureau of Standards)

Introduction.

THIS pamphlet describes the construction and operation of a simple receiving set which has about the same receiving range as the one described in the first pamphlet and will respond to the same wave frequencies (wave lengths). The advantage of this set is that it is more "selective," which means that it is easier to distinguish the message from one of two radio transmitting stations when both of the transmitting stations are using wave frequencies (wave lengths) that are nearly the same. This greater selectivity is brought about through the use of two complete electric circuits, both of which are tuned to the incoming waves. This is in contrast to the single-circuit equipment.

The total cost of this equipment can be kept down to about $15.00. Most of the equipment mentioned in Circular No. 120 can also be used with this set, and the cost of the additional apparatus will be about $5.00.

Essential Parts of Receiving Station.

Antenna, Lightning Switch, Ground Connections, and Telephone Receivers. The other essential part of the equipment is the receiving set, which is made up of the following parts:

Coupler, (Left half of Fig. 1).—This is composed of a fixed section and a movable section. The fixed section is made up of the coil tube P, the upright support J, the contact panel K and the base B. The movable section is composed of the coil tube S, the supporting contact panel M and the base L. The movable section is so arranged that the coil tube S slips inside of the coil tube P when M is pushed to the left. The coil tubes are made by winding wire on cardboard tubing.

This pamphlet tells how to construct a coupler in the home. It is of course possible to purchase a coupler of the type here described at almost any store which handles radio supplies. Another type of device, called a "vario-coupler," has a rotating coil. In purchasing any coupling device, care should be taken to select one which will operate satisfactorily with the condenser available, at the wave frequencies to be received.

Variable Condenser (C, Figs. 1 and 2).—The variable air condenser should have a maximum capacity rating between 0.0004 and 0.0005 microfarads (400 to 500 micromicrofarads).

Crystal Detector, (D, Figs. 1 and 2).—This is essentially the same crystal detector as was described in Circular 120 except that a few improvements have been made in its construction.

Accessories.—Under the heading of accessory equipment may be listed binding posts, switch arms, switch contacts, test-buzzer, dry battery, and boards on which to mount the complete apparatus. The binding posts, switch arms, and switch contacts may be purchased from dealers who handle such goods or they may be readily improvised at home. The pieces of wood on which the equipment is mounted may be obtained from a dry packing box and covered with paraffin to keep out moisture. Care should be taken in melting the paraffin not to get it too hot and it should not be heated beyond the point where it just begins to smoke. The paraffin may be melted in a pan set in boiling water in order to eliminate the possibility of getting it too hot. When the wood parts have been drilled and cut to size the paraffin should be applied quickly with a small brush. When cold, the excess paraffin should be carefully scraped off with a straight piece of metal such as the brass strip in the edge of a ruler.

Details of Coupler Construction.

Movable Coil Tube, Coil Tube Support and Base (S. M. & L. Fig. 1).—The coil tube S is a piece of cardboard tubing, 3 5-8 inches in diameter and 4 inches long. A round cardboard table-salt box which can be obtained at a grocery store is about 3 5-8 inches in diameter and can be used for this purpose. One of the cardboard ends or caps should be securely glued to the box. This tube is wound with No. 24 (or No. 26) double cotton covered copper wire.

Punch two holes in the tube 3-8 inch from the open end, as shown at R., Fig. 2. Weave the end of the wire through these holes so that it is firmly anchored and has one end extending about 10 inches inside the tube. Punch a hole F about 5-8 inch from the other end (which has the cardboard cover secured to it) in line with the holes punched at R. Draw the free end of the wire through the inside of the tube and thread it out through the hole at F. Now wind on 10 turns of wire and take off a 6-inch twisted tap, as described in Circular 120. Hold the turns tight and punch a hole B directly underneath this tap. Insert the end of the tap in the hole and pull it through the inside of the tube so that the turns are held in place. The hole for this tap should be slightly staggered from the first two holes which were punched. Punch another hole L 5-8 inch from the other end of the tube and in line with the hole B. Thread the twisted tap out through this hole and pull it tight. Wind on 10 more turns and bring out another twisted tap; then 10 more turns and another tap; 15 turns and another tap; 15 more turns and another tap. Finally, wind on 20 more turns and bring out the free end of the wire in the same manner as the taps were brought out. The tube now has 80 turns of wire would on it and there are 5 twisted taps and two single wires projecting through the row of holes at the closed end of the tube. The position of the wires inside the coil tube is shown by the dotted lines.

The contact panel M (Fig. 1) which supports the coil tube is a piece of dry wood 5 1-2 inches high, 4 inches wide and 1-2 inch thick. The contacts, switch arm and knob, and binding posts are described in Circular No. 120. The end of the switch arm should be wide enough so that it will not drop btween the contact points, but not so wide that it cannot be set to touch only a single contact. Having located the hole for the switch-arm bolt, the switch arm should be placed in position and the knob rotated in such a manner that the end of the contact arm will describe an arc upon which the contact points are to be placed. The holes for the contacts should next be drilled, the spacing depending upon the kind of contacts which are to be used.

The movable base L is a square piece of dry wood 4 inches long, 4 inches wide and about 3-4 inch thick. Care should be taken to have the edges of this block cut square with respect to the sides.

The panel M should now be screwed to the movable base L, as shown in Fig. 1. Care should be taken to have the edges of the blocks M and L evenly lined up so that the two edges of the block L (Fig. 1) which slide along the inside edges of the strips H and I will be smooth continuous surfaces.

Fixed Coil Tube and Panel, (P and K, Fig. 1).—The coil tube P (Fig. 1) is essentially the same as the tuner described in Circular 120, and the tuner used there may be made a part of P, of this set. The cardboard cover should be glued to the end of the tube where the single turn taps are taken off. This tube is 4 1-8 inches in diameter and 4 inches long. If a new coil tube is constructed, it may be improved by using a somewhat different arrangement of the twisted taps. (See coil marked "Tuning Coil" in Fig. 3, Circular 120.) Instead of taking off taps in a line from the upper right corner to the lower left corner of the figure, start at the upper left corner and progress downward to the lower right corner. The end of the coil tube where the 10-turn taps are taken off should have the cardboard cover

(Continued on page 8.)

*This is the second of a series of pamphlets on the construction of radio receiving equipments. Those who expect to construct the set herein described should first obtain a copy of Bureau of Standards Circular, No. 120, "Construction and Operation of a Simple Home-Made Radio Receiving Outfit," by writing the Superintendent of Documents, Government Printing Office, Washington, D. C., and enclosing five cents. Cash may be sent at risk of sender or remittance may be made by money order. Stamps will not be accepted. That Circular was originally issued in mimeographed form as "Bureau of Standards Letter Circular, No. 43."

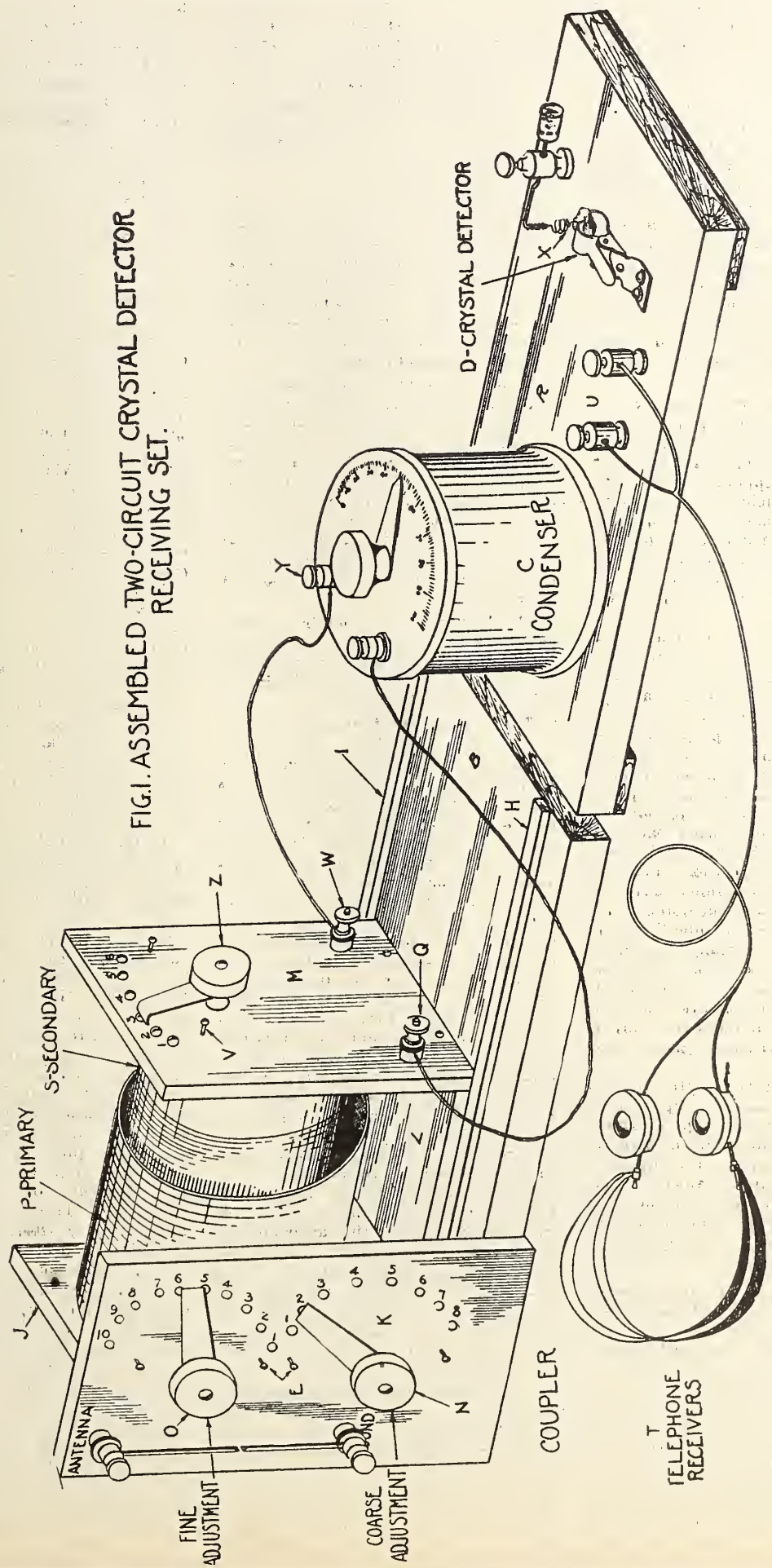


FIG. I. ASSEMBLED TWO-CIRCUIT CRYSTAL DETECTOR RECEIVING SET.
D-CRYSTAL DETECTOR
C CONDENSER
S-SECONDARY
P-PRIMARY
ANTENNA
GND
FINE ADJUSTMENT
COARSE ADJUSTMENT
COUPLER
TELEPHONE RECEIVERS
T
J
K
L
M
N
Q
U
V
W
X
Y
Z

glued to it. This is the top of the coil tube as it is shown in the diagram (Fig. 3, Circular 120). In all other respects the tube is wound exactly as described in Circular 120.

The panel which was described in Circular 120 may also be used for the panel K (Fig. 1). If the receiving set described in Circular 120 has not been constructed, this panel may be made from a board 7 1-2 inches long by 4 1-2 inches wide and about 1-2 inch thick. The position of the contacts can be determined by inserting the switch arms in their respective holes and turning the knobs so that the ends of the switch-arms will describe arcs, as previously explained. The contacts, and switch arms and knobs are described in Circular 120.

Fixed Base and Coil Tube Support, (B and J, Fig. 1).—The fixed base B is a piece of dry wood 5 1-2 inches wide, 11 inches long and between 3-4 and 7-8 inch thick. The support J for the fixed coil tube is 5 1-2 inches wide (the width of the base), 6 inches long and about 1-2 inch thick. This board should be screwed to one end of the base so that it is held securely in a vertical position. It will then project about 5 inches above the base G.

A strip of wood 1, 11 inches long, 5-16 inch wide and about 1-4 inch thick is now fastened to the base by cigar-box nails or small brads so that it is even with the rear edge, as shown in the drawing (Fig. 1). The upright panel M, having been fastened to the movable base L, as previously explained, is placed in position as shown. The next step is to locate the strip H in such a position that the block L will slide easily back and forth the entire length of the fixed base B. Having found this position this strip is secured in the same manner as the trip 1. It is, of course, understood that neither the movable coil tube S nor the switch contacts and binding posts have, up to the present time, been mounted on the upright panel M. The wooden parts for the loose-coupler are now finished and should be covered with paraffin according to instructions given under "Accessories."

It might be advisable after winding the coil tubes P and S to dip them in hot paraffin. This will help to exclude moisture. It is important to have the paraffin heated until it just begins to smoke, as previously explained, so that when the coils are removed they will have only a very thin coating of paraffin.

Variable Condenser and Crystal Detector.

Variable Condenser, (C, Figs. 1 and 2).—The variable air condenser should have a maximum capacity of between 0.0004 and 0.0005 microfarads (400 to 500 micromicrofarads). The type pictured in Fig. 1 is inclosed in a round metal case, but the unmounted type may also be used. A person adept with the use of tools can make the variable air condenser, but a discussion of the method is not within the scope of this pamphlet. The variable condenser is mounted on a board R (Fig. L) about 10 inches long, 5 1-2 inches wide and 3-4 inch thick. This board is similar to the baseboard used for the set described in Circular 120. The strips of wood are fastened under the ends so that the wires may be run underneath for connections. After the holes for the detector binding post, and also the holes for the telephone binding posts U have been drilled, the board should be coasted with paraffin as previously described.

Crystal Detector, (D, Figs. 1 and 2).—The galena crystal may be mounted as described in Circular 120, or it may be mounted as pictured in Figs. 1 and 2. The holder for the crystal is a metallic pinch-clip such as the ordinary battery test clip or paper clip. This clip should be bent into a convenient shape so that it may be fastened to the base.

The wire X, which makes contact with the crystal, is a piece of fine wire (about No. 30) which is wound into the form of a spring and attached to a heavy piece of copper wire (about No. 14). This heavy wire is bent twice at right angles, passes through the binding post, and has a wood knob or cork fixed to its end as shown. It is desirable to have the fine wire of springy material such as German silver, but copper wire may be used if necessary.

The importance of securing a tested galena crystal can not be emphasized too strongly, and it should be understood that good results can not be obtained by using an insensitive crystal.

Instruction for Assembling and Wiring.

Coupler. The movable portion of the coupler should be assembled first. As shown in Fig. 1, the fittings making up this part of the set are the movable base L, the coil tube support M and the coil tube S. Insert in M the 6 switch contacts (machine screws), the switch-arm, and the binding posts, in the proper holes which have been drilled. Adjust the switch arm until it presses firmly on the contact points (bolt-heads) and fasten the bare end of a No. 24 copper wire between the nuts on the end of the switch-arm bolt 2 (Figs. 1 and 2) which projects through the panel M. Wind this wire into the form of a spiral of two or three turns like a clock-spring, leaving a few inches of the wire for connection. Insert two small screws V (Fig. 1) in the panel M so that the switch-arms will not drop off the row of contact points when the knob is turned too far.

The coil tube S is now ready to be fastened in position on the panel M. Cut a one-inch hole in the cardboard end of the coil tube and place it with the closed end next to the panel M in such a position that it will be just below the row of nuts and washers (switch contacts) and in the center of the panel M with respect to the sides. Fasten it to the panel with short wood screws. The switch-arm bolt with the spiral wire connected to it should project through the hole cut in the end of the coil tube. Thread the end of this wire through a hole punched near the end of the coil tube next to the panel and connect this wire to the back of the binding post W (Figs. 1 and 2). The wire F (Fig. 2) is now connected to the back of the binding post Q. There now remain 5 twisted taps and 1 wire to be connected to the 6 switch contacts. The taps should be cut off about 1 1-2 inches from the coil tube and the insulation removed from the pairs of wires thus formed. Each pair of wires should be twisted together, as shown at J, (Fig. 2.) The connections are now made by clamping the 5 taps and also the end of the single wire between the nuts and washers on the contact bolts. The connections are clearly shown in the diagram.

We are now ready to assemble and wire the fixed portion of the coupler, composed of the base B, coil support J, panel K and coil tube P. As previously mentioned, the panel K is practically the same as the panel shown in Circular 120 except that for this purpose the original panel is mounted so that the lower edge now becomes the left hand edge. This brings the series of ten contacts at the top of the panel in our present set. When the panel is turned to this position the two binding posts will be at the top. Change the position of the right-hand binding post so that the two are arranged as shown in Fig. 1. Connections between the binding posts and switch-arms are made as described in Circular 120. Two short pieces of wire should now be fastened under the binding posts at the front of the panel. These wires are arranged so that there is a very short space between their ends, as explained in Circular 120. Screw the panel K to the base B and to the support J, meanwhile allowing the coil tube P to lie on the base so that the connecting wires will not be broken.

If the panel has been made especially for this coupler, as described in this pamphlet, it should be mounted according to the following instructions:

Screw the panel to the base and to the support J and insert the binding posts, switch-arms and bolts, and contact bolts in the proper holes. The switch-arms should now be adjusted so that they make firm contact on the heads of the bolts. Now insert 4 small screws E, (Fig. 1) in the front of the panel so that the switch-arms will not drop off the row of contact points where the knobs are turned too far. Insert a wire between the nuts on the end of the lower switch-arm bolt N where it projects through the back of the panel K (Fig. 1). Wind the wire into a spiral of 1 o 2 turns like a clock spring and connect the end to the upper binding post which is marked "Antenna." These connections will be understood by referring to the upper left-hand corner of Fig. 2.

In the same manner connect another wire from the upper switch arm bolt to the lower binding post which is marked "Ground." (See Fig. 2.) The connecting wires should be insulated except where a connection is needed and should not touch each other. Two short pieces of wire are now fastened to the binding posts in the front of the panel, as previously explained.

The coil tube P should now be laid on the base in about the same position as it is shown in Fig. 1. The 16 twisted taps and also the 2 single wires from the

(*Continued on page 10.*)

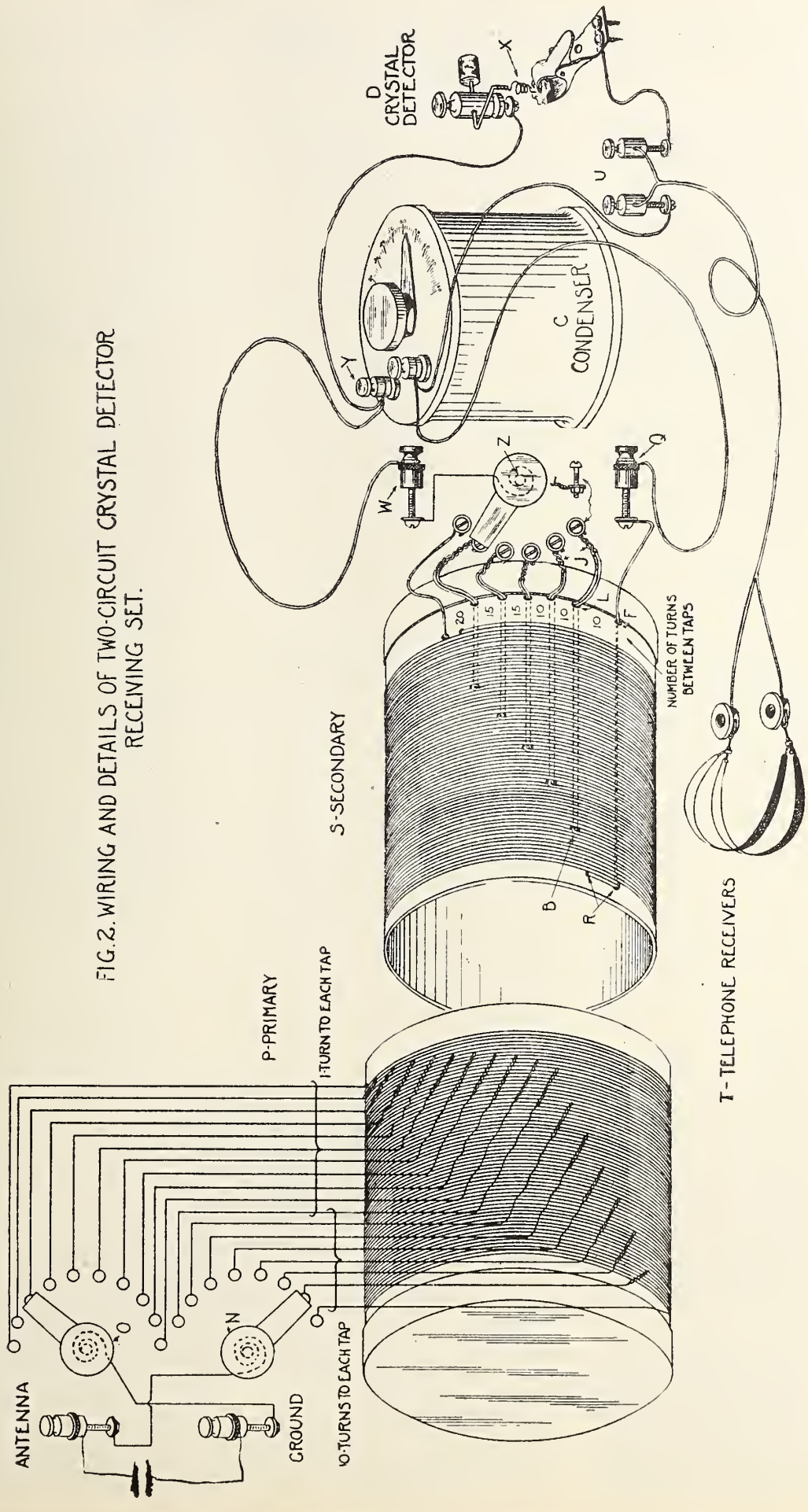


FIG. 2. WIRING AND DETAILS OF TWO-CIRCUIT CRYSTAL DETECTOR RECEIVING SET.

ends of the winding are now to be connected to the back of the 18 contacts on the panel K, following the method given in Circular 120. The order of connecting the taps may be understood by referring to Fig. 2.

Carefully raise the coil tube P against the support J to such a position that when the coil tube S of the movable section of the tuner is pushed in the coil tube P, the space between the two tubes will be equal all around.

Mark this position of the coil tube P on J, and fasten it to J with short wood screws.

Condenser and Crystal Detector, (C and D, Fig. 1).—The mounting of the condenser C and the crystal detector D on the base R is clearly shown in Fig. 1. Crystal detectors have been previously described in this pamphlet and in Circular 120. A wire is run from the binding post Y on the variable condenser C, through a small hole in the base R, and is then connected to the under side of the detector binding post. Another wire is now run from the clip which holds the galena crystal, through a small hole in the base, and is then connected to the under side of the right-hand binding post U. The left-hand binding post U is next connected to the binding post on the variable condenser which has no wire attached to it, by running a wire under the base and up through a small hole. The wiring will be understood by referring to the right-hand portion of Fig. 2. The wires may be the same size as were used for winding the coil tubes and should be insulated. Two pieces of wire should now be connected from the binding posts W and Q (Figs. 1 and 2) to binding posts on the variable condenser. The telephone receivers T are now connected to the binding posts U and the receiving set is complete except for connecting to the antenna and ground.

The connection of the antenna lead and ground wire to the binding posts marked "Antenna" and "Ground" respectively is made as shown in Fig. 2 in Circular 120.

The coil tube P is usually called the "primary" and the coil tube S is usually called the "secondary."

Directions for Operating.

Push the coil tube S (secondary)about half way into the coil tube P (primary) and set the switch 2 on contact point 4. The primary switch N is set on contact point 8. The primary switch O may be left in any position. The crystal detector can be adjusted most easily by the use of the test buzzer, which is described below. If the test buzzer is not used the wire which rests on the crystal must be placed lightly at different points on the crystal until the transmitting station is heard when the set is adjusted as described below.

Having adjusted the crystal detector to a sensitive point, the next thing is to adjust the switches on the coil tube P (primary), the switch on the coil tube S (secondary) and also the variable condenser C so that the apparatus will be in "resonance" with the transmitting station. Set the primary switch N on contact point 1 and while keeping it in this position move the other primary switch O over all of its contacts stopping a moment at each one. Care should be taken to see that the ends of the switch arms are not allowed to rest so that they will touch more than one contact point at a time. If no signals are heard, set the switch arm N on contact point 2 and again move the switch-arm O over all of its contacts. Proceed in this manner until the transmitting station is heard. This is called "tuning" the primary circuit.

The tuning of the secondary circuit is the next operation. Set the secondary switch Z on contact point 1 and turn the knob of the variable condenser C so that the pointer moves over the entire scale. If no signals are heard, set the switch 2 on contact point 2 and again turn the knob of the variable condenser so that the pointer moves over the entire scale. Proceed in this manner until the signals are loudest, being careful to see that the ends of the switch-arms touch only one contact point at a time. Next slide the coil tube S (secondary) in and out of the coil tube P (primary) until the signals are made as loud as possible. This operation is called changing the "coupling." When the coupling which gives the loudest signal has been secured, it may be necessary to readjust slightly the position of the switch-arm O, the position of the movable coil tube S and the "setting" of the variable condenser C.

The receiving set is now in resonance with the transmitting station. It is possible to change the position of one or more of the switch-arms, the position of the movable coil tube and the setting of the variable condenser in such a manner that the set will still be in resonance with the same transmitting station. In other words, there are different combinations of adjustments which will tune the set so that it will respond to signals from the same transmitting station. The best adjustment is that which reduces the signals from undesired stations to a minimum and still permits the desired transmitting station to be heard. This is accomplished by decreasing the coupling (drawing coil tube S farther out of coil tube P) and again tuning with the switch-arm O and the variable condenser C. This may also weaken the signals from the desired transmitting station but it will weaken the signals from the undesired stations to a greater extent, provided that the transmitting station which it is desired to hear has a wave frequency which is not exactly the same as that of the other stations. This feature is called "selectivity."

The Test Buzzer.—As mentioned above, it is easy to find the more sensitive spots on the crystal by using a test buzzer. This has been described in Circular 120 and is shown at Z, Fig. 3, in that publication. Referring to this figure, the binding post marked "ground" should be connected by a flexible wire to the binding post W, which is shown in Fig. 1 in this pamphlet.

Approximate Cost of Parts.

The following parts are used in the equipment described in Circular 120 and are needed also for the two-circuit set described in this pamphlet.

Antenna:		
	Wire—copper, bare or insulated No. 14 or 16, 100 to 150 ft., about	$ 0.75
	Rope—1-4 or 3-8 inch, 2c per foot	
2	Insulators—porcelain	0.20
1	Pulley	0.15
	Lightning Switch—30-ampere battery switch	.030
1	Porcelain Tube	0.10
Ground Connections:		
	Wire (same kind as antenna wire)	
2	Clamps	0.30
1	Iron Pipe or Rod	0.25
Receiving Set:		
3	Ounces No. 24 double cotton covered copper wire	0.40
1	Round Cardboard Box	
2	Switch Knobs and blades, complete	1.00
18	Switch Contacts and nuts	0.75
3	Binding Posts—set-screw type	0.45
2	Binding Posts—any type	0.30
1	Crystal—tested	0.25
3	Wood Screws—brass, 3-4 inch long	0.03
2	Wood Screws for fastening panel to base	0.02
	Wood for panels (from packing box)	
2	Pounds Paraffin	0.30
	Lamp Cord—2 to 3 cents per foot	
	Test Buzzer	0.50
	Dry Battery	0.30
	Telephone Receivers	$ 4.00 to $ 8.00
	Total	$10.35 to $14.35

The following additional parts will be required:

3	Ounces No. 24 double cotton covered copper wire	$ 0.40
1	Round Cardboard Box	
1	Switch Knob and blade, complete	0.50
6	Switch Contacts and nuts	0.25
2	Binding Posts—any type	0.30
1	Battery Clip for crystal	0.10
	Miscellaneous Screws	0.30
1	Variable Condenser—0.0004 to 0.0005 microfarads (400 to 500 micromicrofarads	3.00 to 6.00
	Total additional cost	$ 4.85 to $ 7.85

A One Tube Set

(*Continued from page 5.*)

tubes may be used, including the W-D-11.

The phone condenser "8" is a .001 fixed mica condenser. Any good phones of 2,000 ohms or more may be used, and a variable "B" battery of 22 1-2 volts will supply the plate current. To tune the set, it should be handled in the same way as any ordinary regenerative set and a little practice is all that is needed to accomplish this. The values of the phone condenser, grid condenser and leak plate and filament voltages have much to do with the efficient working of the instrument.

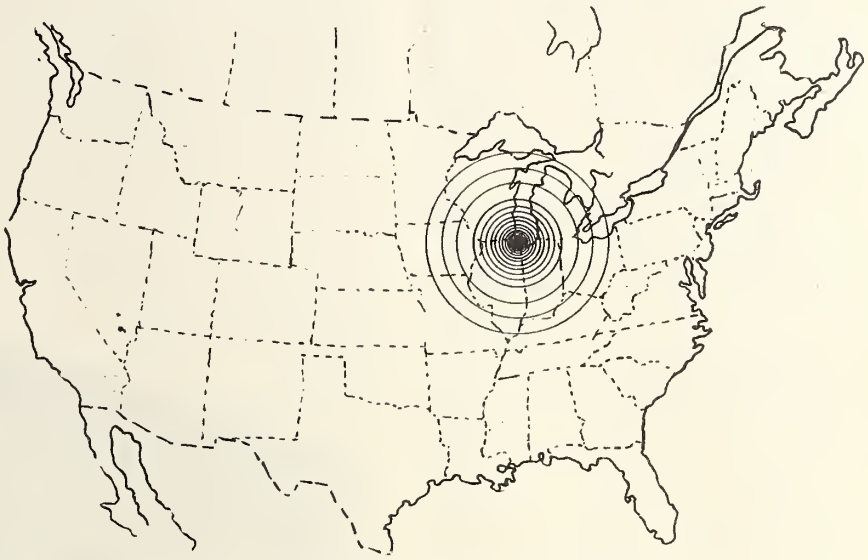
Local and long distance reception can be obtained with this set if the instructions are carefully followed.

The Super-Radio Survey

By L. J. LESH

THE writer has been actively interested for several years in the subject of radio broadcasting, both by telegraph signals and voice. This interest first resulted in the design, construction and operation of privately owned transatlantic receiving stations located in the offices of The New York Times and The Philadelphia Public Ledger.

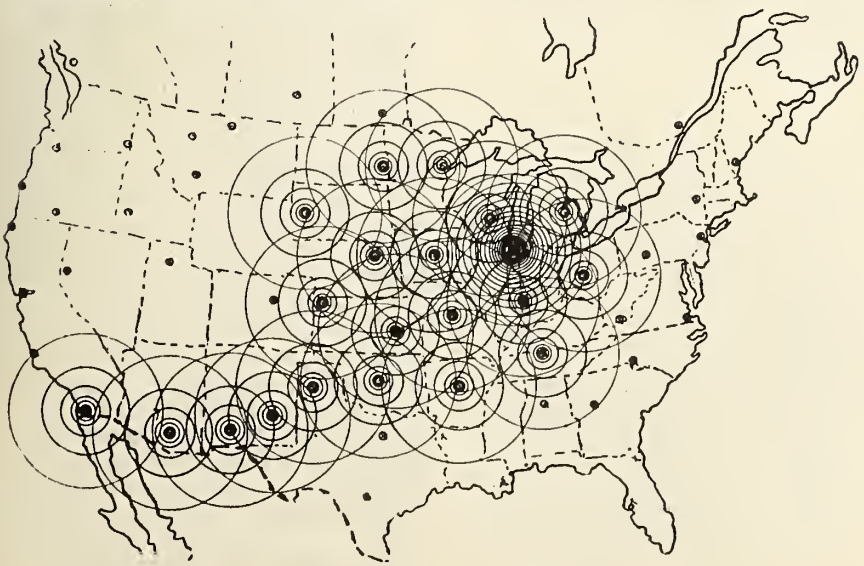
These stations successfully copied the radio news broadcasts transmitted from Nauen, Germany, and Bordeaux, France, in addition to regular news items addressed to the papers in question. A considerable saving in time was thus effected over reception and retransmission over land lines from the more distant receiving stations of the company conducting the transmission. This direct service was effective about four months out of the year but during the remainder of the time was seriously interfered with by static.



RELIABLE DAYLIGHT RANGE OF CHICAGO BROADCASTING STATION UNDER PRESENT OPERATION.

Following the suggestion of the writer, a centralized receiving station was located in Canada where summer static is somewhat reduced and the messages dispatched over land lines to the newspapers with a minimum of delay and no confusion with the mass of regular commercial radio correspondence which is transmitted at a much higher charge per word and would otherwise claim priority in delivery to destination.

Shortly after the World War it became apparent that radiophone transmitters had reached a state of development where they could be used practically for broadcasting voice and music distances of over five hundred miles. It became evident that the voice on the air might serve the large newspaper syndicates in delivering news to their subscriber publications scattered over the country and the International News was approached on the subject. Through the encouragement of its director, Mr. Marlin Pew, a study was made of this problem and a report submitted in which the various advantages and difficulties were pointed out in comparison with the method of distribution in use employing an elaborate network of leased telegraph wires and "looped" or broadcast wire, telephone circuits enabling one announcer at a central office to transmit news items to a number of telephone subscribers simultaneously, these subscribers being the small publications served by the syndicate.



SUPERADIO BROADCAST USING PART OF EXISTING STATIONS TO COVER MIDWEST U.S. AND OPEN SOUTHERN ROUTE TO CALIFORNIA. OTHER STRATEGIC STATIONS SHOWN.

It was concluded that the establishment of a very powerful radio voice distributing station in the centre of the country, which appeared to be the logical solution, was somewhat premature and it seemed best to wait and watch developments. In spite of this decision it might be mentioned that even at that date, about three years ago, the engineers of the large corporation perfecting the radio telephone informally expressed themselves as confident that the plan was feasible and that a central voice broadcasting station radiating sufficient energy to reach the desk of about one-half of the small newspaper editors of the country could be built and economically operated except during the worst periods of summer static interference.

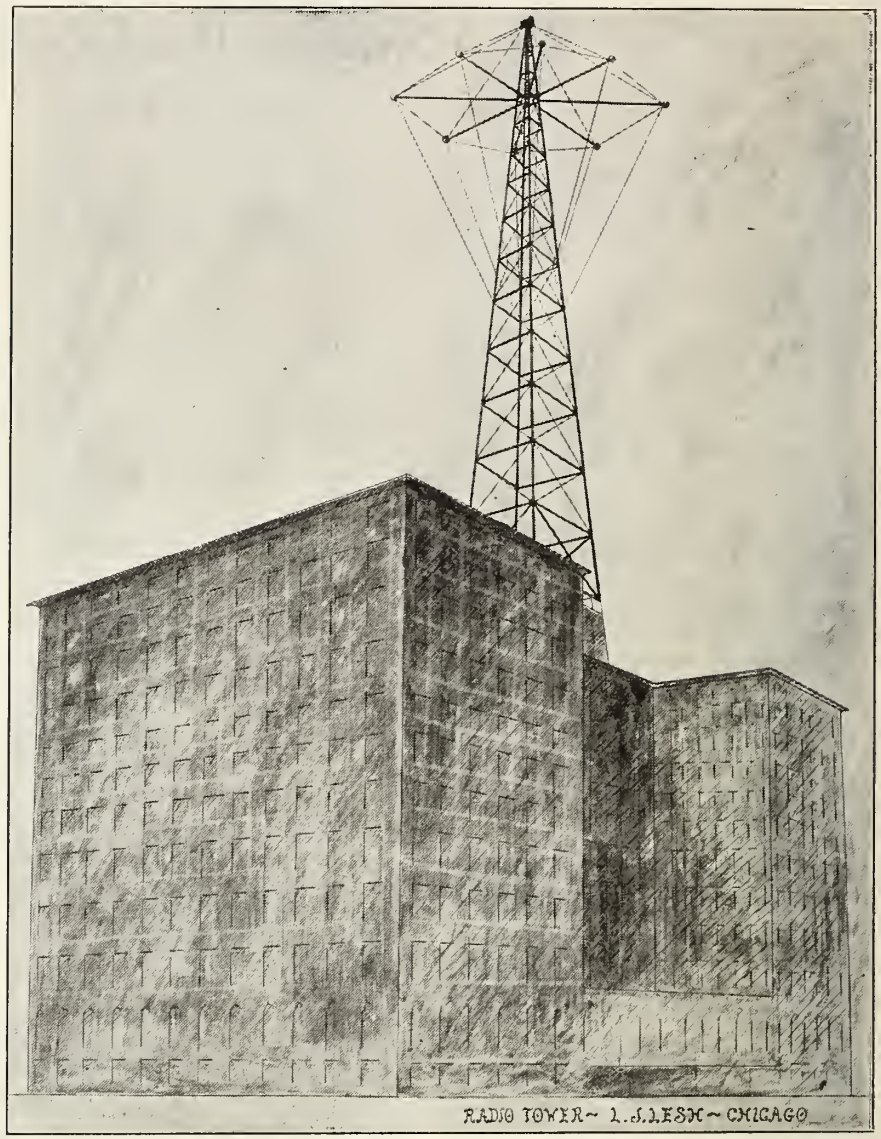
This static bugbear meant that in all probability the syndicates would have to revert to the land lines for a period during the summer and from the leased wire standpoint this was an impossible situation.

Considerable water has flowed under the bridges since that time and it now appears that the static

difficulty can be overcome. The plan will be described as the Superradio Survey after its big brother, the Super-Power Survey which links together the power plants and network of electrical distribution wires of the eastern part of the United States, effecting many economies and nicely balancing the demand and supply of electricity for light heat and power in the cities as well as the small towns.

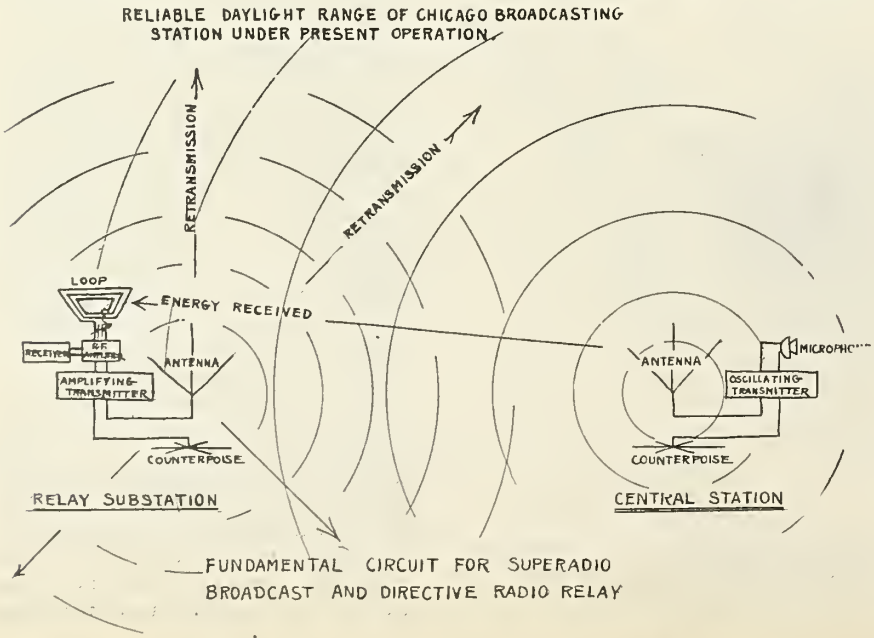
At present the situation in radio broadcasting is highly chaotic and inefficient. It will be even more so during the coming summer when static limits the daylight range of the most powerful broadcasting stations to a few hundred miles during daylight unless something is done to improve matters. So long as the listeners are only tuning in for musical concerts, static and weakened signals will merely spoil their pleasant evenings with the loud speaker, but for that portion of the daily broadcast which endeavors to get market prices of commodities to the large audience of farmers and small town listeners the failure of transmission will result in a serious economic loss all around.

The only way known at present to cope with static or atmospheric interferences in radio is to overpower the static. That is to project such a powerful volume of radio voice that the received intensity exceeds that of the static crashes and noises. The radio receiving set may then be adjusted so that it will only respond to the voice or music wave while the static of lesser intensity is unable to open the door or climb in the window, so to speak.



Within about one hundred miles of a very powerful broadcasting station, the voice is understandable even during the worst parts of the summer using proper receiving equipment which need not be expensive. Considering this fact in relation to the broadcasting of market quotations from Chicago it becomes obvious that in order to reach out five hundred miles, as is necessary, either the power of the central transmitter at Chicago must be enormously increased or a method of relaying the voice to the outlying districts must be adopted. The transmitter necessary to give an audible voice at five hundred miles would be very expensive and cumbersome with the additional disadvantage that the signal intensity would be unevenly and inefficiently distributed, being unnecessarily loud near the central station and weakest at the limits of reception where, unfortunately the broadcast information is most interesting on account of distance and absence of other sources of news.

Relaying the voice by means of radio substations appears to be the only solution and I will now describe how this is to be done from

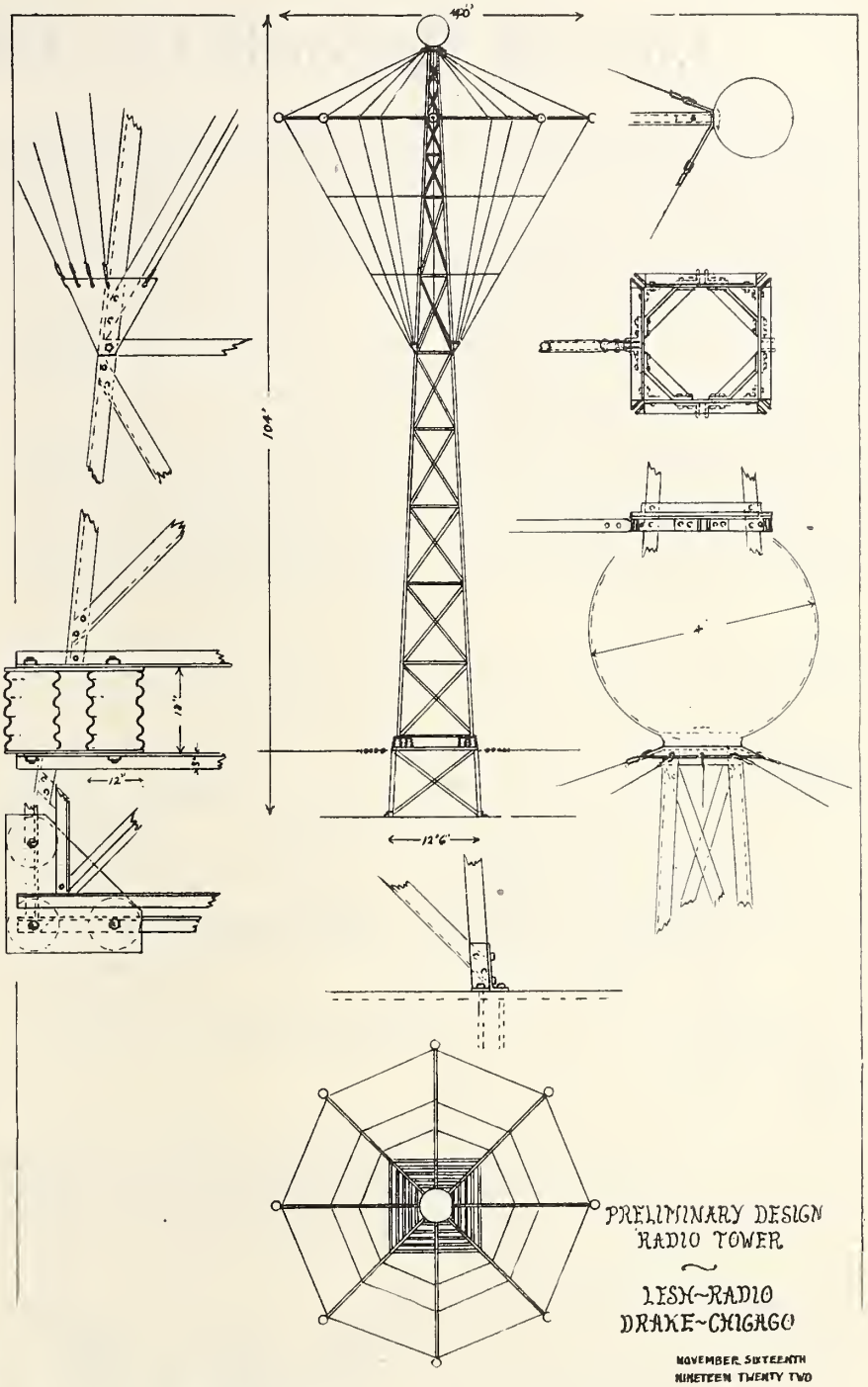


a central station, WDAP located on the Drake Hotel, Chicago, owned by the Chicago Board of Trade and operated by the Midwest Radio Central of which Thorne Donnelly and J. Elliot Jenkins are the principals. For the central radiating structure, the writer has designed a new form of tower, serving the purpose of a transmitting antenna. This tower, which is entirely of metal, is insulated at its base and has been approved by competent authorities from an electrical and mechanical standpoint. It will be energized by a three killowatt radiophone transmitter tuned very sharply as to wave length. The direct range of this equipment is expected to exceed two hundred miles during the worst periods of daylight reception in the summer.

Within a range of two hundred miles of Chicago there are located several smaller radiophone transmitting stations and where possible, these together with other special stations to be erected will serve as substations or relays "boosting" the voice of the central station onward during the period of transmission of vital information, such as market values, with the result that the entire area within five hundred miles of Chicago will be "blanketed" by the voice of WDAP to an even intensity at all parts of the region. The cooperation of local Boards of Trade and similar institutions in the smaller cities in this matter is quite assured from the fact that they receive their market quotations from Chicago.

The design of the substations or relays offers little difficulty and will add very little to the cost of existing available broadcast transmitters which may be easily adapted to the new function. The method employed will be to pick up the voice of the central station on a receiving loop and amplify the energy at radio frequency by means of the local transmitter maintained, of course, in a non-oscillating condition. The operator of the substation will be able to listen to the signal as it passes through his relay and easily tune his transmitter so that it amplifies only the voice of the central station. The use of a directive loop for reception will further assist him in avoiding the amplification of signals from other broadcasting stations unless they happen to be on exactly the same wave length as the radio central and in the same direction.

A further expansion of the Super-Radio Survey will apply to the general broadcasting of music and news all over the country with the practical annihilation of static except in isolated cases. To accomplish this result, an arrangement will be worked out whereby radiophone transmitters not engaged in direct broadcasting will operate as tuned amplifiers of energy picked up from active stations, reradiating the distant music or voice over a local area. The proper employment of the relaying principle will also make possible a degree of directive radio telephony at desired periods, broadcasting stations across the country being linked in line so that a message may be transmitted from coast to coast with a minimum amount of total power, the signal intensity at the terminal station, say three thousand miles away, being the same as the voice heard only two hundred miles from the point of origin.



In conclusion, it might be pointed out that the thought of relaying radio has been suggested many times before and is even now being practiced but in a much different manner than that outlined by station KDKA at Pittsburgh. KDKA picks up the Arlington time signals on long wave, reduces them to audio frequency and then causes the

(*Continued on page 30.*)

Pick-up Records by Our Readers

I enclose a "hook-up" and also a very good idea which I believe never to have been published in any Radio magazine before.

I am enclosing a list of the stations that I have heard with this hook-up. They are as follows: KDKA, East Pittsburgh; KDZL, Ogden, Utah; KFAF, Denver, Colo.; KWY, Chicago; WBAY, New York; WDAP, Chicago; WDAJ, College Park, Ga.; WDAI, Syracuse, N. Y.; WDAF, Kansas City; WDAA, Nashville; WCX, Detroit; WCM, Austin, Texas; WBT, Charlotte, N. C.; WFAA, Dallas, Texas; WGM, Atlanta, Ga.; WGY, Schenectady, N. Y.; WHA, Madison, Wis.; WHAS, Louisville, Ky.; ——, Atlantic City; WHB, Kansas City; WIAF, New Orleans; WNAC, Boston; WMAQ, Chicago; WKY, Oklahoma City; WLW, Cincinnati; WLAG, Minneapolis; WLAP, Louisville, Ky.; WLD, Ludington, Mich.; WSB, Atlanta; WOU, Omaha, Nebr.; WOR, Newark, N. J.; WOS, Jefferson City, Mo.; WOC, Davenport, Iowa; WOAN, Lawrenceburg, Tenn.; WOAI, San Antonio, Texas; WSY, Birmingham, Ala.; KSD, St. Louis; WBAP, Ft. Worth; WDAE, Tampa, Fla.

Last night when I started to tune in all I did was turn the rheostat that controls the filament just about one-fourth inch and I heard someone talking but it was not clear so I turned the rheostat I have in the ground and this is what I heard, "This is the Atlanta Journal."

I have an aerial 125-feet long and a counterpoise the same length. I hear on an average of fifteen to twenty stations in three hours. The farthest being Salt Lake City, a distance of about 2,000 miles.

I hope that you will publish all information I have sent and also this letter if you wish.

Yours very truly,
LEON P. SAID,
1065 So. Wellington St., Memphis, Tenn.

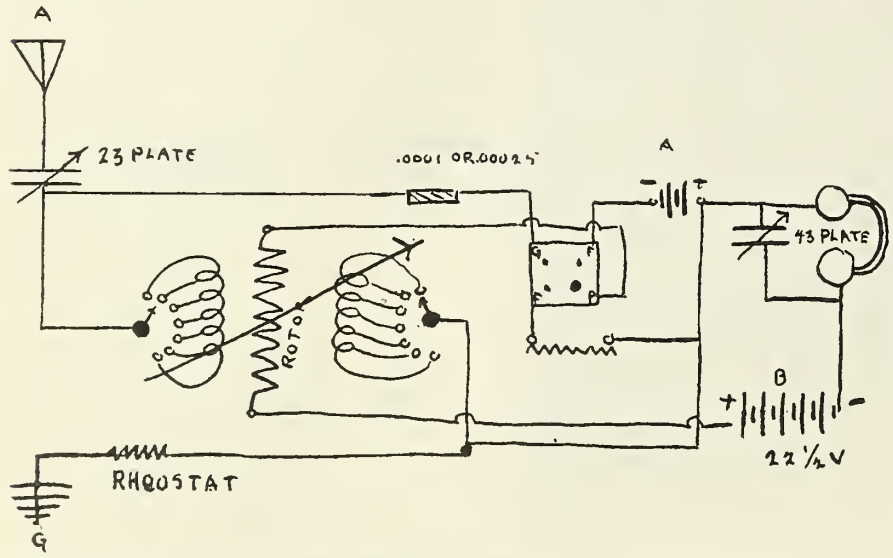
Radio Fans:

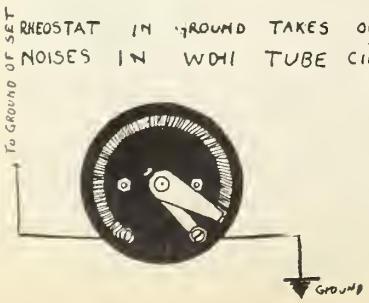
Here is something that might hold your interest awhile. This hook-up is an improvement on one published some time ago in the "Mail" and you can take it from your Uncle Dudley that it is a Lulu. It is the sad truth when I say there are many radio fans who, when relating the merits of their own pet hook-ups, draw somewhat upon their imagination and sometimes strain the credulity of those listening. But don't, please, put me in that category when I say I have got PWX, Havana, Cuba and CFCA, Toronto, Canada, on one tube and have been able to tune in PWX while WJZ was on. Can get any one of the local stations loud enough to put on my speaker, also on one tube.

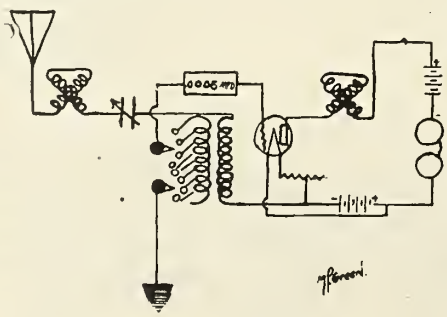
Am using a two-wire aerial, 150 feet long, with an 85-foot lead-in.

Live in Washington Heights, New York, on the ground floor of an apartment house. Use 46-plate vernier type condenser. This is proof to me that it pays to experiment.

MYRON P. GREEN,
560 W. 192nd Street, N. Y.





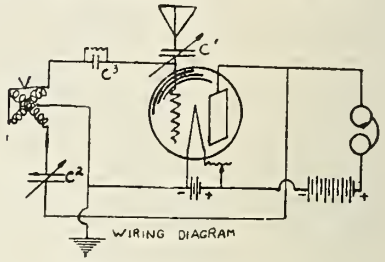


Duke's Demon

The hookup illustrated below is all that the name implies—it is a demon for audibility.

Material required: 1 variometer; 1 43-plate condenser; 3 binding posts; 1 open circuit jack; 1 venier rheostat; 1 socket; 1 grid condenser with leak; 1 23-plate condenser.

In the illustration C1 is the 23-plate condenser and C2 is the 43-plate. In connecting the variometer first be sure that the rotor is in series between the halves of the stator, then shunt the ends of the rotor and take a lead from there to the ground. This connection is the secret of the set and should be made exactly as stated. The 23-plate condenser, C1, is not necessary when only broadcasting is wanted as the natural wave-length of the set is higher than 200 meters. If less than 300 meters is wanted the 23-plate condenser is necessary in the antennae circuit.



This set is very sharp on the variometer and regeneration is controlled with the 43-plate condenser. Audibility is better than any hook up the writer has tried and is equal to that of a single-circuit of the most popular type using one-stage of amplification —*From Carl E. Duke, 2625 Yale Boulevard, Springfield, Ill.*

John A. Barnes, 5911 MacPherson Avenue, St. Louis, writes:

I have been reading your radio column and would like to submit to you the record I obtained on a two slide, one tube set with a one wire antenna, the stations and their air line distance from St. Louis:

WOC, 200 miles	WL2, 400 miles
WHB, 200 miles	WBAP, 550 miles
WSB, 500 miles	WLAD, 400 miles
WGM, 500 miles	WDAJ, 520 miles
WDAL, 750 miles	KDKA, 600 miles
WMAK, 650 miles	KYW, 250 miles
WWJ, 450 miles	

I believe this to be good for the type of set I am using.

Varsity Radio

Authorities of the University of Pennsylvania have announced that a course in "principles underlying radio communication" will be added to the curriculum.

Questions and Answers

P. A. A., Burlington, Wis.

Question: I have just within the past two months "hooked up" with your valuable paper. I have become interested in winding a Reinartz tuner and have been trying to get some information as to the winding of the inductance. I am submitting a few questions which, if you will please answer, will clear up my difficulty. What is the size of the form on which the winding is made, using D. C. C. 22 wire, if this size is suitable? What is the proper position of the three windings on the form, and the proper number of turns to the taps of each winding? According to the diagram I have of the Reinartz hook-up two of the windings are continuous with a tap on the back, or between these windings for a lead to the negative filament. Is this correct? About what wave length will this tuner cover? I would like it to run from 300 to at least 600 meters. Am not particular about size. I will appreciate it very much if you will answer the above questions.

Answer: No. 22 is rather large. Better use No. 24. Form 6 1-2 inches in diameter will do. Would suggest that you get a copy of the September issue, which contains all this information. Wave length is 170 to 570 meters.

G. L. W., Chicago, Ill.

Question: Sometime ago I wrote you in regard to a hook-up diagram of a Reinartz tuner, using one step of radio frequency amplification, but as I did not receive an answer, evidently you did not receive my letter. I have constructed a Reinartz tuner from your article in the November issue of Radio Age. I would now like to put in one step of radio frequency amplification. Will you kindly send me a diagram for this circuit?

Answer: Great Scott, G. L. W., if you knew the number of inquiries this department is getting these days, you would not wonder why you did not get your circuit, but I am making good right now and mailing it to you. Hope you have good luck with it.

L. A. H., Ellis, Kansas.

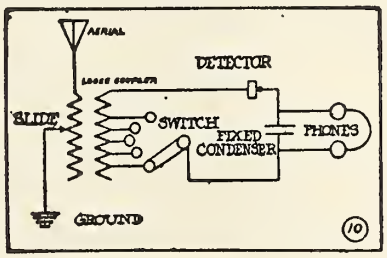
Question: About a week ago I sent you a list of my troubles with the Reinartz coil which I made. I am not sure that I sent a stamped envelope for reply. I enclose one in this letter. I also forgot to state that I used rubber and braid covered wire for the set wiring. My aerial is No. 14 solid copper, 75 feet long and 35 feet high. I rewired the set last night, using No. 16 bare copper, which made a decided improvement in the set. Was necessary to shield the tuner with tin foil. With it, in a few minutes I had Davenport, Iowa, Minneapolis, Atlanta, Ga., Dallas, Texas, and Los Angeles, Calif. Used Cunningham amplifier tube C-301 as a detector and one stage of amplification. My detector tube, C-300, cannot get anything through it. Lights up O. K. Have tested the grid and plate terminals, with tube out of circuit and the phone receivers show a circuit through to the filament when it is lighted, but when in the set I get nothing. Referring to the tuner coil, I am using rubber tubing on the taps leading to the switch contacts. Would this have any effect on it?

Answer: The rubber and braid covered wire did not cause your trouble. You probably repaired some poor connection when you rewired it. Once in a while you will find a tube which for some reason will not oscillate. This is probably your answer. Keep the amplifier tube, it is a dandy. The rubber tubing is all right and is just as good as the other insulations.

J. W. R., Milwaukee, Wis.

Question: Wish to ask you if you would kindly draw a diagram for me, showing just how and where the different connections should be on a loose coupler crystal radio set? On the other side of this sheet I have given full description of my set as far as I got with it, but am puzzled about the connections. Your information will be much appreciated.

Answer: Drawing of the circuit follows.



J. F. S., Peoria, Ill.

Question: Enclosed find diagram of set. Is this a good one, and how far can I hear with it? Please send me a diagram of how to make a good tube set out of this one.

Answer: The set is a good one if you reverse the position of the two condensers shown to the right of the variometer. It will not function well as shown. Am mailing a circuit showing how to make the change to a tube set.

F. H., Chicago, Ill.

Question: I have two transformers from a Western Electric set. Each has five taps, marked as shown in the enclosed sketch, and numbered as shown. I would like to hook up this transformer on a Reinartz tuner having one step of radio and one step of audio frequency, described in the November issue of the Radio Age. Will you please send me a sketch showing how to hook these transformers up to this set?

Answer: This transformer can only be used for the audio frequency amplification, and you will not need a sketch for it. Use the contacts 1 and 2 for the primary connections as shown in the November issue, and use contacts 3 and 5 for the secondary connections.

F. F. F., St. Louis, Mo.

Question: I am constructing a Reinartz set according to the plans in your magazine. I note an article in the question and answer department which says this set is limited to receive on 130 to 370 meters. Now the broadcasting in this locality is on 400 to 485 meters. Can you instruct me how to build this set to receive up to 500 meters? I would also like to have instructions for tuning.

Answer: This statement was a mistake, as the tuner as described will tune to something over 400 meters, and is capable of receiving waves of 485 meters without any change. If, however, it does not come in as clear as desired, the coil can be rewound, and a few more turns put on to the aerial coil. The same result can be obtained by putting a little inductance in the aerial circuit. The tuning of this set is a matter of practice and no set rules can be given which will apply in every case.

Hook-up Ideas Are Worth $1

EACH radio fan who experiments finds something about design or operation that will help his fellow fan. Send in your new hook-ups and other original devices, accompanied by clearly drawn diagrams. Radio Age will pay $1 for all such original articles and drawings used. Text should be limited to about two hundred words.

Phonograph Attachment

The Gilbert H. Downey Co., 7 South Seventeenth Street, Philadelphia, Pa., have completed and have ready for distribution their new "E-C" (Easy Change) phonograph attachment for the Victor and Columbia phonographs.

This attachment is complete with special loud speaking unit (with cord) and aluminum case, which fastens on to the tone arm of the phonograph after the reproducer is removed. There are no set-screws to injure the unit.

A phonograph with the "E-C" attachment makes a loud-speaker for the home at a very low cost.

FREE! WITH HOOK-UPS!

REINARTZ RADIO, most popular booklet of year, sent postpaid with one year's subscription to Radio Age for only $2.00. This is Special Offer for April. Get one while they last. Send currency, check or money order to Radio Age, 64 West Randolph Street, Chicago, Ill.

The Monthly Service Bulletin of the

NATIONAL BROADCASTERS' LEAGUE

Solely by, of and for Radio Broadcasting Station Owners

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Arthur E. Ford, E. E.
State University of Iowa
First Vice President

W. J. Baldwin, W S Y
Alabama Power Co.
Birmingham, Ala.
Second Vice President

Frederick A. Smith
Garrick Building,
Chicago
Secretary

Founded to promote the best interest of Radio Broadcasting stations in the United States and Canada.

Executive Offices, Garrick Building, Chicago, Ill.

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Detroit, Mich.

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Midwest Radio Central, Inc.
Drake Hotel, Chicago, Ill.

H. A. Trask, K S D
St. Louis Post Dispatch
St. Louis, Mo.

Frank W. Elliott, W O C
Palmer School of Chiropractic
Davenport, Ia.

RADIO CONFERENCE.

Just before going to press with this issue, Radio Age received from the Department of Commerce the following announcement, dated March 6:

"The Department of Commerce has sent out invitations for a reassembly of the radio conference held a year ago, together with some additional members.

"The conference held last year was for the purpose of considering legislation necessary in order to reduce the amount of interference in radio broadcasting. The legislation having failed to pass Congress it is felt desirable to investigate what administrative measures may properly be taken temporarily to lessen the amount of interference in broadcasting.

"Since the last conference the number of broadcasting stations has increased from 60 to 581, and it is estimated that somewhere between 1,500,000 to 2,500,000 receiving stations are now in use. The amount of interference has increased greatly and threatens to destroy the growth of the art.

"The conference will start on Tuesday morning, March 20, at 11 o'clock at the Department of Commerce."

Arrangements were at once made to insure the presence of representatives of the National Broadcasters' League at this conference. Details will be published in the May issue.

"PIKER CODE-SENDERS."

Radio Age:

I am a constant reader of Radio Age and appreciate your paper and pointed editorials. Can't you do something with those "piker code-senders," who are always spoiling the concerts with their foolish prattle?

Silent night in Chicago is a joke when they permit these heroes to butt in and "destroy the air." If they must play the hog let them put mufflers on their claptraps. Concerts coming in from the South and West tonight, Monday, March 5, were really spoiled by these pikers.

Please do something for the cause and thousands will thank you.

Sincerely,

A READER AND BOOSTER.

We also had some trouble tuning out several industrious code-senders on the night mentioned. But we must all admit that the fellows who used to have the air all to themselves have shown a commendable spirit in trying to play the game and the Relay League itself is doing what it can. In radio pursuits patience must be something more than a virtue. It must be a habit. Still we admit that had it not been for our pious nature we should have done a little swearing on the night of the 5th.—[The Editor.

OWNERS of broadcasting stations who have not yet joined the National Broadcasters' League, may do so by sending their check for the annual membership fee of $10 to Frederick Smith, Secretary, Garrick Building, Chicago.

Membership will entitle broadcasters to periodical information as to developments in connection with broadcasting, intelligence as to steps taken to eliminate the present almost disastrous interference and news of events in any part of the country affecting broadcasting and broadcasting interests. Also members will receive the official organ of the league for one year.

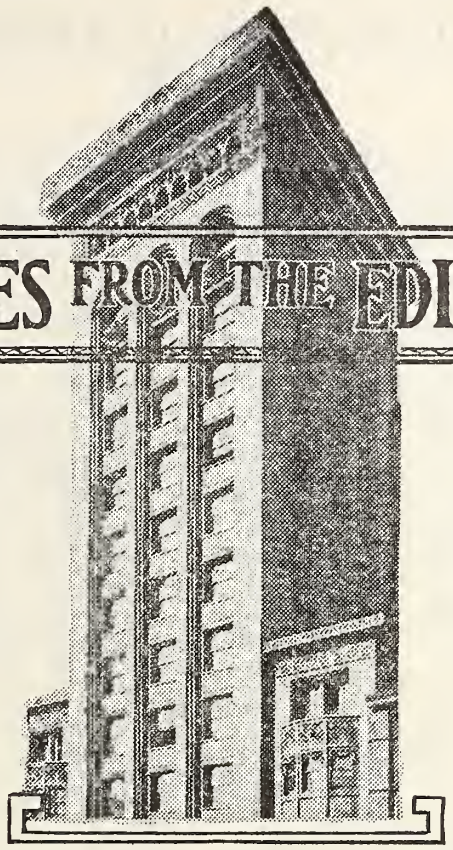
This nominal fee is required for the cost of issuing circulars and handling the large volume of correspondence. You will find it useful to be associated directly with this clearing house for broadcasting information, which is also a protective institution, offensive and defensive.

The Department of Commerce has advised broadcasters through the medium of the Radio Service Bulletin that they must comply with regulations and confine their radio activities to broadcasting. A broadcasting license does not permit special tests of radio telephone or telegraph apparatus, communication with specific stations, either ashore or at sea, or any transmission except entertainment, market and weather reports and news on 360 or 400 meters, as the license may specify.

Some stations have stopped acknowledging letters, telegrams and telephone calls, but they talk to one another, conduct contests, which approximate advertising, and some carry on experiments of various kinds. This practice has become so general the Departmental Officials state some new regulations may have to be provided. Special licenses and waves are necessary for code work, station to station transmission and experimental work. There are too many stations licensed for such operation now, it is explained, and when the broadcasters enter this field the interference increases.

All station owners are advised to give their licenses the "once over" and familiarize themselves with exactly what they are permitted to do.

Send $1.00 to Radio Age, 64 Randolph Street, Chicago, and receive this middle-west radio periodical for six months. Regular subscription price is $2.50 a year.



THOUGHT WAVES FROM THE EDITORIAL TOWER

IN the January issue of the "World Wide Wireless," a house organ published by the Radio Corporation of America, there appears the following quotation from Daniel Webster:

"Constantly Clamoring.

"There are persons who constantly clamor. They complain of oppression, speculation and the pernicious influence of accumulated wealth. They cry out loudly against all banks and corporations and all means by which small capitals become united in order to produce important and beneficial results. They carry on mad hostility against all established institutions. In a country of unbounded liberty they clamor against oppression. In a country of perfect equality they would move heaven and earth against privilege and monopoly. In a country where the wages of labor are high beyond parallel they would teach the laborer that he is but an oppressed slave."—[Daniel Webster.

In view of the fact that the Radio Corporation was accused in the latest session of Congress of attempting to monopolize the radio industry to the detriment of the fans this quotation is significant.

It is all the more interesting when we pause to consider that the Radio Corporation has undertaken a series of patent suits which would prevent competitors from making equipment necessary to the radio art. The corporation has sued Grebe and it has sued De Forest and both defendants contend that if the corporation wins the victory will tend to give the Woolworth Building people a monopoly.

Does the corporation, in quoting Daniel Webster, mean to imply that in opposing monopoly of radio manufacture and sale radio fans are aligning themselves with labor agitators and chronic kickers? If so there are some other pertinent quotations from sources just as credible as the great Webster from whom we have received counsel about monopolies.

In 1641 the Massachusetts General Court established the "Body of Liberties," which was the first code of laws authorized in New England. This code in section 9 provided:

"No monopolies shall be granted or allowed amongst us, but of such new inventions that are profitable to the country, *and that for a short time.*"

Perhaps the corporation has not read what Francis Bacon, the premier essayist, wrote about monopolies in 1625. Then again, probably the corporation did read Bacon's essays and, to put it in the vernacular, got a hunch from them. In essay XXXIV Bacon wrote:

"Monopolies, and coemption of wares for re-sale, where they are not restrained, are great means to enrich; especially if the party have intelligence what things are to come into request, and so store himself beforehand."

Then there is Adam Smith. Back in 1776, Smith wrote "Wealth of Nations" the best all-around statement of the science of economics ever published. This peerless scholar and thinker believed that free competition would permit industrial problems to solve themselves and the practical maximum of efficiency would be reached.

Adam Smith was a clamorer, too, it seems. He wrote:

"A monopoly granted either to an individual or to a trading company has the same effect as a secret in trade or manufactures. Monopolists, by keeping the market constantly understocked, by never fully supplying the effectual demand sell their commodities much above the natural price and raise their emoluments, whether they consist in wages or profits greatly above the natural rate.

"The price of monopoly is upon every occasion the highest that can be got. The natural price, or the price of free competition, on the contrary, is the lowest that can be taken, not upon every occasion, indeed, but for any considerable time together. The one is upon every occasion the highest that can be squeezed out of the buyers, or which it is supposed, they will consent to give: The other is the lowest which the sellers can commonly afford to take, and at the same time continue their business."

Yes, radio fans, in "constantly clamoring" are only following illustrious examples reaching back for centuries. If the fans ever stop clamoring against monopoly in tubes let them expect, as Adam Smith says, to pay the highest prices "that can be squeezed out of the buyers."

Any individual, publication, corporation or company that favors a monopoly in radio manufacture or sales is an enemy of popularized radio.

THE WHITE Radio Bill died in committee along with a number of other important legislative documents when the 67th Congress adjourned on March 4. The House and Senate do not convene until December 4, when a new bill will probably be introduced—but that is nine months away.

Whether Secretary Hoover can manage to keep the ether from getting more jammed with broadcasts and other radio communications without legislation, remains to

(*Continued on page 30.*)

Corrected List of U. S. Stations Alphabetically by Call Signals

Complete Each Issue

THE list of broadcasting stations on these pages is brought up to date each month by additions of new stations and deletion of those which have suspended operation. The list is the product of a vast volume of correspondence and its completeness is due in large measure to the assistance of our special news service in Washington, D. C. Suggestions, corrections and additional data will be welcomed from readers. Broadcasters: Send in your program schedules.

IXAD, Pawtucket, R. I, 300 and 600 meters; 1000 miles; Special license experimental; Standard Radio & Electric Co.
KDKA, E. Pittsburgh, Pa.; Class B station, up to 485 meters; Westingbouse Elec. & Mfg. Co.
KDN, San Francisco, Calif.; Leo J. Meyberg Co.
KDOW, Steamship America, New York.
KDPM, Cleveland, Ohio; Westinghouse Elec. & Mfg. Co.
KDPT, San Diego, Calif.; Southern Elec. Co.
KDYL, Salt Lake City, Utab; news music, entertainment, Telegram Publishing Co.
KDYM, San Diego, Calif.; Savoy Theatre.
KDYQ, Portland, Ore.; Oregon Inst. Technology.
KDYS, Great Falls, Mont.; Class B, 485 meters, Great Falls Tribune.
KDYV, Salt Lake City, Utah; Cope & Cornwell Co.
KDYW, Phoenix, Arizona; Smith Hughes & Co.
KDYX, Honolulu, T. H; 360 wave length; 12:15 to 1:15 p. m., stock reports and weather; 6:30 to 7:30 p. m., music, lectures; Sundays, 11 a. m. to 12:30 p. m., sermon; Honolulu Star-Bulletin, Ltd.
KDZA, Tucson, Ariz.; Arizona Daily Star.
KDZB, Bakersfield, Calif.; Frank E. Seiffert.
KDZE, Seattle, Wash.; Rhodes Co.
KDZF, Los Angeles, Calif.; Automobile Club of Southern California.
KDZG, San Francisco, Calif.; Cyrus Pierce & Co.
KDZH, Fresno, Calif.; Fresno Evening Herald, Class B, 845.
KDZI, Wenatchee, Wash.; Electric Supply Co.
KDZK, Reno, Nev. Wednesday 8 to 9 p m; Friday 8 to 9 p m. Musical and news features; Nevada State Journal, Nevada Machinery & Electric Co.
KDZL, Ogden, Utah; Rocky Mountain Rad. Corp.
KDZM, Centralia, Wash.; E. A. Hollingworth.
KDZQ, Denver, Colo.; Motor Generator Co.
KDZX, San Francisco, Calif.; Glad Tidings Tabernacle.
KDZZ, Everett, Washington; Kinney Broe. & Sippreli.
KFAD, Phoenix, Ariz.; Class B, 485, McArtbur Bros. Mercantile Co.
KFAE, Pullman, Wash.; State College of Washington.
KFAF, Denver, Colorado; George S. Walker, Western Radio Corporation; musical programs, news items, etc., daily except Tuesday and Sunday, 8 to 9 p m; mountain standard time.
KFAJ, Boulder, Colo.; University of Colorado.
KFAN, Moscow, Idaho; Electric Shop.
KFAP, Butte, Mont.; Standard Pub. Co.
KFAQ, San Jose, Calif.; City of San Jose.
KFAR, Hollywood, Calif.; Studio Lighting Service Co.
KFAS, Reno, Nev.; Reno Motor Supply Co.
KFAT, Eugene, Ore. Monday, Wednesday and Saturday 8 to 9 p m Music; Sunday 8:30 to 9:15 Church Services; Pacific Radio Co.
KFAU, Boise, Idaho; Class B, 485, Boise High School.
KFAV, Venice, Calif.; Abbott Kinney Co.
KFAW, Santa Anna, Calif.; Class B, 485, Radio Den.
KFAY, Central Point, Ore.; W. J. Virgin Milling Co.
KFAZ, Reddley, Calif., C. H. Weatherll.
KFBB, Havre, Mont.; F. A. Buttrey & Co.
KFBC, San Diego, Calif.; W. K. Azbill.
KFBD, Hanford, Calif.; California Radio Lab.
KFBE, San Louis Obiapo, Calif.; R. H. Horn.
KFBG, Tacoma, Wasb.; First Presbyterian Church.
KFBH, Marshfield, Ore.; Thomas Musical Co.
KFBK, Sacramento, Calif., 2,000 miles; daily, 3 to 4 p m and 6 to 6:30 p m; Sunday and Thursday 8 to 9 p m; Kimball-Upson Co. and Sacramento Union.
KFBL, Everett, Wash.; Lesse Bros.
KFBU, Laramie, Wyo.; N. S. Thomas.
KFBV, Colorado Springs, Colo.; Clarence O. Ford.
KFCB, Phoenix, Ariz.; Nielson Radio Supply Co.
KFCC, Wallace, Ida.; Auto Supply Co.
KFCD, Salem, Ore.; F. S. Barton.
KFCF, Walla Walla, Wash.; Frank A. Moore.
KFCH, Billings, Mont.; Elec. Service Station.
KFCK, Colorado Springs, Colo.; Colorado Springs Radio Co.
KFCM, Richmond, Calif., Richmond Radio Shop.
KFCP, Ogden, Utah, Ralph W. Flygare.
KFCY, Houston, Tex., Fred Mahaffey, Jr.
KFCY, Le Mars, Ia.; Western Union College.
KFCZ, Omaha, Nebr.; Omaha Central High School.
KFDA, Baker, Ore.; Adler's Music Store.
KFDB, San Francisco, Calif.; Mercantile Trust Co., also 400.
KFDD, Boise, Idaho; St. Michael's Cathedral.
KFDO, Bozeman, Mont.; Everett H. Cutting.
KFDP, Des Moines, Ia.; Hawkeye Radio & Supply Co.
KFDS, San Francisco, Calif.; John D. McKee.
KFDU, Lincoln, Nebr.; Nebraska Radio Electric Co.
KFDV, Fayetteville, Ark.; Gilbrech & Stinson.
KFEB, Taft, Calif.; City of Taft.
KFEQ, Oak Nebraska; J. L. Scroggin.
KFCQ, Casper, Wyo.; Motor Service Station.
KFDL, Denver, Colo.; Knight Campbell Music Co.
KFDJ, Corvallis, Ore.; Oregon Agri. College.
KFDC, Spokane, Wash.; Radio Supply Co.
KFDF, Casper, Wyo.; Wyoming Radio Corp.
KFDR, York, Nebraska; Bullock's Hardware & Sporting Goods.
KFEC, Portland, Ore.; Meier & Frank Co.
KFEL, Denver, Colo., Winner Radio Corp.
KFEP, Denver, Colo., Radio Equipment Co.
KFEQ, Oak, Nebraska; J. L. Scroggin.
KFER, Fort Dodge, Ia.; Auto Electric Service Co. Inc.
KFEV, Douglas, Wyo.; Entertainment and weatber; Radio Electric Sbop.
KFFA, San Diego, Calif.; Dr. R. C. Shelton.
KFGL, Los Angeles, Calif.; Los Angeles Union Stock Yards.
KFEJ, Tacoma, Wash.; Guy Greason.
KFFE, Pendleton, Ore.; Eastern Oregon Radio Co.
KFFQ, Colorado Springs, Colo., Marksheffel Motor Co.
KFGF, Mt. Vernon, Wash.; Buchanan, Stevens & Co.
KFGG, Astoria, Ore.; Astoria Budget.
KFGH, Stanford Univ., Calif.
KFHJ, Santa Barbara, Calif., Fallon Co.
KFGB, Pueblo, Co., Loewenthal Bro.
KFI, Los Angeles, Calif.; Earl C. Anthony, Inc.
KFU, Gridley, Calif.; The Precision Shop.
KFV, Yakima, Wash.; Foster-Bradbury Radio Store.
KFZ, Spokane, Wash.; Doerr-Mitchell Elec. Co.
KGB, Tacoma, Washington, Tacoma Daily Ledger; H. F. Higgins.
KGG, Portland, Ore.; Hallock & Watson Radio Service.
KGN, Portland, Ore.; Northwestern Radio Mfg. Co.
KGO, Altadena, Cal. 2500 miles; every Saturday 8 to 9:30 p m Musical program; Paul Franklin Johnson, Altadena Radio Lab.
KGU, Honolulu, Hawaii, Waikiki Beach, Marion A. Mulroney; Honolulu Advertiser.
KGW, Portland, Ore.; Oregonian Pub. Co., also 400.
KGY, Lacey, Wash.; St. Martin's College, (Rev. S. Ruth).
KHD, Colorado Springs, Colo.; Class B, 485, C. F. Aldrich; Marble & Granite Co.
KHJ, Los Angeles, Cal; 400 meters, daily, 12:30 to 1:15 p m; from 7 to 7:30 p m and 8 to 9:30 p m; Los Angeles Times Mirror Co.
KHQ, Seattle, Wash.; Louis Wasmer.
KJJ, Sunnyside, Calif.; The Radio Shop.
KJQ, Stockton, Calif.; C. O. Gould.
KJS, Los Angeles, Calif.; Bible Inst. of Los Angeles.
KLB, Pasadena, Calif.; J. J. Dunn & Co.
KLM, Del Monte, Calif.; Noggle Elec. Works.
KLP, Los Altos, Calif.; Colin B. Kennedy Co.
KFDH, Tucson, Ariz.; Univ. of Arizona.
KLS, Oakland, Calif.; Warner Bros.
KLX, Oakland, Calif.; Tribune Pub. Co.
KLZ, Denver, Colo.; Class B, 485, Reynolds Radio Co.
KMAZ, Macon, Ga., Mercer University.
KMC, Reedley, Calif.; Lindsay-Wetherill Co.
KMJ, Fresno, Calif. Max. 2576 Miles; Musical program, San Joaquin Light & Power Corp.
KMO, Tacoma, Wash., Love Electric Co.; Tacoma Times.
KNI, Eureka, Calif.; T. W. Smith.
KNJ, Roswell, New Mexico, 360, 485, 1000 miles; Every evening at 8; news, weather reports, stock market, concerts and sermons; Roswell Public Service Co.
KNN, Los Angeles, Calif.; Bullocks.
KNT, Aberdeen, Wash.; North Coast Products Co.
KNV, Los Angeles, Calif.; Radio Supply Co.
KNX, Los Angeles, Calif.; Elec. Lighting Supply Co.
KOA, Denver, Colo.; Y. M. C. A.
KOB, State College, N Mex. 485 also; time signals and weather reports 12 noon and 10: p m, mountain time; music and lectures Monday, Wednesday and Friday, 7:30 to 8:30 p m; New Mexico College of Agriculture and Mechanical Arts.
KOE, Spokane, Wash.; Spokane Chronicle.
KOG, Los Angeles, Calif.; Western Radio Electric Co.
KON, Los Angeles, Calif.; Holzwasser, Inc.
KOP, Detroit, Mich., Detroit Police Dept.
KOQ, Modesto, Calif., Modesto Evening News.
KPO, San Francisco, Calif., Hale Bros.
KQI, Berkeley, Calif., Univ. of California.
KQP, Hood River, Ore., Blue Diamond Elec. Co.; Hood River News.
KQV, Pittsburgh, Pa., Doubleday-Hill Elec. Co.
KQW, San Jose, Calif., Chas. D. Herrold.
KQY, Portland, Ore; 1,000 miles, Monday, Tuesday, Saturday, 9 to 10 p m; Wednesday, Thursday, Friday, 6 to 7 p m; Stubbs Electric Co.
KRE, Berkeley, Calif., Maxwell Electric Co.
DSC, San Jose, Calif., O. A. Hale & Co.
KSD, St. Louis, Mo.; 1700 miles; 485 meters; grain, livestock, cotton, New York stocks, poultry and butter market, metal market, official weather and news at 9:40, 10:40, 11:40, 12:40, 1:40, 2:40 and 4 p m; 8: p m 400 meters, musical and other features; Pulitzer Publishing Co., St. Louis Post Dispatch.
KSL, San Francisco, Calif., The Emporium.
KSS, Long Beach, Calif., Prest & Dean Radio Research Lab.
KSU, Wenatchee, Wash., 360 and 485.
KTW, Seattle, Wasb., First Presbyterian Church.
KUO, San Francisco, Calif., Examiner Printing Co., San Fran. Examiner.
KUS, Los Angeles, Cal. 500 miles; setting up exercises daily, 7 to 7:30 a m and 12:00 noon to 12:30 p m; concert, 65 voices, 6 to 6:45 p m, Wednesdays and Fridays; City Dye Works.
KUY, Del Monte Calif., Coast Radio Co.
KWG, Stockton, Cal. Daily Market reports, music and news 4 to 5 p m; Music, 2 to 3 p m, Sunday; Tuesdays and Fridays, music, 8 to 9 p m. Portable Wireless Telephone Co.
KWH, Los Angeles, Calif., 485 also Los Angeles Examiner.
KXD, Modesto, Calif., Herald Publishing Co.
KXS, Los Angeles, Calif., Braun Corp.
KYI, Bakersfield, Calif., Alfred Harrell.
KYJ, Los Angeles, Calif., Leo J. Meyberg Co.
KYQ, Honolulu, T. H., The Electric Shop.
KYW, Chicago, Ill., Westinghouse Elec. & Mfg. Co.
KZC, Seattle, Wash., Public Market & Dept. Store Co.
KZM, Oakland, Calif., Western Radio Inst.; Preston D. Allen.
KZN, Salt Lake City, Utah, The Deseret News.
KZV, Wenatchee, Wash., Wenatchee Battery & Motor Co.
NOF, Anacostia, D. C., 412 only, U. S. Navy Dept.
PWX, Havana, Cuba, Cuban Telephone Co.
WAI, Dayton, Ohio, McCook Field, U. S. Army.
WAAB, New Orleans, La., Valdemar Jensen.
WAAC, New Orleans, La., Tulane Univ.
WAAD, Cincinnati, Ohio, Ohio Mechanics Inst.
WAAF, Chicago, Ill., Chicago Daily Drovers Journal.
WAAE, St. Louis, Mo., St. Louis Chamber of Commerce.
WAAH, St. Paul, Minn.; Commonwealth Electric Co.
WAAJ, Boston, Mass., Eastern Radio Inst.
WAAK, Milwaukee, Wis., Gimbel Bros.
WAAL, Minneapolis, Minn., Minnesota Tribune Co. & Anderson-Beamish Co.
WAAM, Newark, N. J, 200 miles; musical and code, every week day 11 to 11:59 a m, 3 to 4 p m; Wednesday evenings 8 to 9; I. R. Nelson Company.
WAAN, Columbia, Mo., Univ. of Missouri.
WAAP, Wichita, Kans., United Elec. Co.; Otto W. Taylor.
WAAQ, Greenwich, Conn., New England Motor Sales Co.
WAAS, Decatur, Ga., Georgia Radio Co.
WAAT, Jersey City, N. J., Jersey Review.
WAAW, Omaha, Neb., Omaha Grain Exchange.
WAAY, Youngstown, Ohio, Yohrling Rayner Music Co.
WAAZ, Emporia, Kans.; Daylite 100 miles; nite 500-1000 miles; each Tuesday and Thursday from 7 to 8 p m. Acknowledge all communications at 7:15 p m. The Hollister Miller Motor Co.
WAH, El Dorado, Kans., Midland Refining Co.
WAJT, Marshall, Mo., Kelly-Vawter Jewelry Co.
WAJU, Yankton, S. D., Yankton College.
WBAA, W. Lafayette, Ind., Purdue University.
WBAB, Syracuse, N. Y.; Andrew J. Potter.
WBAD, Minneapolis, Minn., Sterling Elec. Co. & Journal Printing Co.
WBAE, Peoria, Ill., Bradley Polytechnic Inst.
WBAF, Moorestown, N. J., Fred M. Middleton.
WBAG, Bridgeport, Pa., Diamond State Fibre Co.
WBAH, Minneapolis, Minn., The Dayton Co.
WBAM, New Orleans, La., J. B. Rennyson.

(Continued on next page.)

Corrected List of U. S. Stations Alphabetically by Call Signals

WBAN, Paterson, N. J., Wireless Phone Corp.
WBAO, Decatur, Ill.; 100 miles; occasional music; sermons; James Millikin Univ.
WBAP, Fort Worth Tex. 400-485; 4000 miles; Markets and News; Feature concert Monday to Friday inclusive; 9:30 p m to 10:45 p m, Central Time; Quiet nights Saturday and Sunday. The Star-Telegram.
WBAQ, South Bend, Ind., Myron L. Harmon.
WBAU, Hamilton, Ohio, Republican Publishing Co.
WBAV, Columbus, Ohio, 485, also Ernest & Hopkins Co.
WBAW, Marietta, Ohio, Marietta College.
WBAX, Wilkes-Barre, Pa., John H. Stenger, Jr.
WBL, Anthony, Kans., T. & H. Radio Co.
WBS, Newark, N. J., D. W. May, Inc.
WBT, Charlotte, N. C. 1200 miles; 11: a m weather report 485; 4:30 p m mechanical music; 8: p m Market Report; 8:30 Tuesday and Friday regular concert; 7:30 p m Sunday, Church Southern Radio Corp.
WBU, Chicago, Ill., City of Chicago.
WBZ, Springfield, Mass., Westinghouse Elec. & Mfg. Co.
WCAB, Newburgh, N. Y., Newburgh Daily News; Newburgh News Printing & Pub. Co.
WCAC, Fort Smith, Ark., John Fink Jewelry Co.
WCAD, Canton, N. Y., St. Lawrence University.
WCAE, Pittsburgh, Pa., 400 also; Kaufmann & Baer Co.
WCAE, Pittsburgh, Pa. 400 meter; 12:30 news and reports; 3:30 weather reports; 4:15 Closing Market reports; 7:30 Late news and lecture; 8:30 musical programs; Kaufmann Baer Co.
WCAG, New Orleans, La., Daily States Pub. Co.
WCAH, Columbus, O. Daily program 11:30 to 12:30; Every Tuesday evening at 7, musical program; C. A. Entrekin Electric Co.
WCAI, San Antonio, Texas, Southern Equipment Co.
WCAJ, Univ. Place, Neb., Nebraska Wesleyan University.
WCAK, Houston, Texas, Alfred P. Daniel.
WCAL, Northfield, Minn., St. Olaf College.
WCAM, Villanova, Pa., Villanova College.
WCAO, Baltimore, Md., Sanders & Stayman Co.
WCAP, Kalamazoo, Mich., Kalamazoo College.
WCAR, San Antonio, Texas, Alamo Radio Elec. Co.
WCAS, Minneapolis, Minn., Wm. H. Dunwoody Industrial Inst.
WCAT, Rapid City, S. Dak., 485 also South Dakota School of Mines.
WCAU, Philadelphia, Pa., 485 also; 1000 miles; Daily 10:30 a m; 2:30 p m; 6:30 p m; regular concert 10 to 12 noon; Tuesdays, Fridays, Saturdays; Durham & Co Inc.
WCAV, Little Rock, Ark., J. C. Dice Elec. Co.
WCAW, Omaha, Nebr., Woodmen of the World.
WCAX, Burlington, Vermont, University of Vermont.
WCAY, Milwaukee, Wis., Kesselman O'Driscoll Co.
WCE, Minneapolis, Minn., Findley Elec. Co.
WCK, St. Louis, Mo., Stix Baer & Fuller.
WCM, Austin, Texas, Univ. of Texas.
WCN, Worcester, Mass., 485 also Clark University.
WCX, Detroit, Mich., Detroit Free Press.
WDAC, Springfield, Ill., Ill Watch Co.
WDAD, Lindsburg, Kas.; Central Kansas Radio Supply.
WDAE, Tampa, Fla., 485 also Tampa Daily News.
WDAF, Kansas City, Mo., 400 and 485, also Kansas City Star.
WDAG, Amarillo, Texas, K. Laurence Martin.
WDAH, El Paso, Texas, Mine & Smelter Supply Co.
WDAI, Syracuse, N. Y., 485 also Hughes Electrical Corp.
WDAJ, College Park, Ga., Atlanta & West Point R. R. Co.
WDAK, Hartford, Conn., Hartford Courant.
WDAL, Jacksonville, Fla., 485 also, Florida Times Union.
WDAO, Dallas, Texas, Automotive Elec. Co.
WDAP, Chicago, Ill., markets, 485; concerts 360; Daily on all business days: 9:30 a. m. receipts and shipments; estimated car lots; local weather report; opening futures market in wheat, corn, oats, rye, barley, pork, lard and ribs. 10 a. m. Future quotations, live stock receipts and prices; 10:30 a. m. futures quotations; 11 and 11:30 a. m. same; 12 noon, futures and cash grain prices; 12:30 and 1 p. m. futures quotations; 1:20 p. m. closing futures quotations and high and low for day. Cash grain prices. Gross bids for cash grain to arrive. 6 p. m. closing quotations; news items. On Saturdays closing prices at 12:05 p. m. instead of 1:20 p. m. Visible supply changes sent when posted. Regular concert schedule 10 p. m. Tuesdays, Thursdays and Saturdays. Sunday evenings 9 p. m. and 10 p. m. Chicago Board of Trade official station.
WDAG, Brownsville, Pa., Hartman-Riker Elec. & Mach.Co.
WDAS, Worcester, Mass., Samuel A. Waite.
WDAU, New Bedford, Mass., Slocum & Kilburn.
WDAX, Centerville, Iowa, First Nat'l Bank.
WDAY, Fargo, N. D., Kenneth M. Hance.
WDM, Washington, D. C., Church of the Covenant.
WDT, New York, N. Y., Ship Owners Radio Service.
WDZ, Tuscola, Ill., James L. Bush.
WEAA, Flint, Mich., Fallain & Lathrop.
WEAB, Fort Dodge, Iowa, Standard Radio Equip. Co.
WEAC, Terre Haute, Ind., Baines Elec. Service Co.
WEAD, Atwood, Kans., Northwest Kansas Radio Supply Co.
WEAE, Blacksburg, Va., Virginia Polytechnic Inst.
WEAF, New York City, N. Y., Western Electric Co.
WEAG, Edgewood, R. I., Nichols-Hineline-Bassett Lab.
WEAH, Wichita, Kans., Wichita Board of Trade and Lander Radio Co
WEAI, Ithaca, N. Y., Cornell University.
WEAJ, Vermillion, S. D.; University of South Dakota.
WEAJ, Vermillion, S. Dak., University of South Dakota.
WEAK, St. Joseph, Mo., Julius B. Abercrombie.
WEAM, North Plainfield, N. J., Burough of N. Plainfield.
WEAN, Providence, R. I., The Shepard Co.
WEAO, Columbus, Ohio, Ohio State University.
WEAP, Mobile, Ala., 485 also Mobile Radio Co.
WEAQ, Berlin, N. H., Y. M. C. A.
WEAR, Baltimore, Md., Balt. American & News Pub. Co.
WEAS, Washington, D. C., The Hecht Co.
WEAT, Tampa, Fla., John J. Fogarty.
WEAU, Sioux City, Iowa, Davidson Bros. Co.
WEAV, Rushville, Nebr., Sheridan Elec. Service Co
WEAW, Anderson, Ind., Arrow Radio Lab.
WEAX, Little Rock, Ark., T. J. M. Daly.
WEAY, Houston, Texas, Will Horwitz, Jr.
WEAZ, Waterloo, Iowa, Donald Redmond.
WEB, St. Louis, Mo., The Benwood Co., Inc.
WEH, Tulsa, Okla., Midland Refining Co.
WEV, Houston, Texas, 485 also Hurlburt-Still Elec. Co.
WEW, St. Louis, Mo., 485 also St. Louis Univ.
WEW, St. Louis, Mo., 860 and 485; Market and weather reports at 9: a m, 10: a m, 2: p m; no other regular program; St. Louis University.
WEY, Wichita, Kansas, 485 also Cosradio Co.
WFAA, Dallas, Texas, 400 and 485 also A. H. Belo & Co.
WFAW, Miami, Fla., 1500 miles; 7:30 to 9 p. m. concerts including Arthur Pryor's Band ovenings and W. J. Bryan Sunday School, Sunday a m; Miami Daily Motropolis & Electrical Equipment Co.
WEAB, Syracuse, N. Y., C. F. Woese.
WFAC, Superior, Wis., Superior Radio Co.
WFAD, Salina, Kans., Watson Weldon Motor Supply Co.
WFAF, Poughkeepsie, N. Y., H. C. Spratley Radio Co.
WFAG, Waterford, N. Y., Radio Engineering Lab.
WFAH, Port Arthur, Texas, Elec. Supply Co.
WFAJ, Asheville, N. C., Hi-Grade Wireless Instrument Co.
WFAK, Brentwood, Mo., Domestic Electric Co.
WFAM, St. Cloud, Minn., 485 also Granite City Elec. Co. and Times Pub. Co
WFAN, Hutchinson, Minn., 485 also Hutchinson Electric Service Co.
WFAQ, Cameron, Mo., Cameron Radio Co. and Mo. Wesleyan College.
WFAS, Fort Wayne, Ind., United Radio Corp.
WFAT, Sioux Falls, S. Dak. 485; also Argus-Leader.
WFAU, Boston, Mass., Edwin C. Lewis.
WFAV, Lincoln, Nebr., 485 also Univ. of Nebr. Dept. of Elec. Engineering.
WFAY, Independence, Kans., Daniels Radio Supply Co.
WFAZ, Charleston, S. Carolina, S. C. Radio Shop.
WFI, Philadelphia, Penn., 400 and 485, also Strawbridge & Clothier.
WGAB, Houston, Texas, QRV Radio Co.
WGAC, Brooklyn, N. Y., Orpheum Radio Stores Co.
WGAD, Ensenada, Porto Rico, Spanish-American School of Radio-telegraphy.
WGF, Des Moines, Iowa 300 miles; Musical and entertainment Tuesday and Friday 7:30 p m; Church Services Sunday at 5 p m or 7:45 p m as announced; Special programs as announced Register and Tribune.
WGAH, New Haven, Conn., New Haven Elec. Co.
WGAJ, Shenandoah, Iowa, W. H. Gass.
WGAK, Macon, Ga. Macon Elec. Co
WGAL, Lancaster, Pa., Lancaster Elec. Supply & Construction Co.
WGAM, Orangeburg, S. C., Orangeburg Radio Equip. Co.
WGAN, Pensacola, Fla., Cecil E. Lloyd.
WGAQ, Shreveport, La., Glenwood Radio Corp.
WGAR, Fort Smith, Ark., Southwest American.
WGAT, Lincoln, Nebr., Am. Legion, Dept. of Nebr.
WGAU, Wooster, Ohio, Marcus G. Limb.
WGAV, Savannah, Ga., B-H Radio Co.
WGAW, Altoona, Pa., Ernest C. Albright.
WGAX, Washington Court House, Ohio, Ohio Radio Elec. Co.
WGAY, Madison, Wis., North Western Radio Co.
WGAZ, South Bend, Ind., South Bend Tribune.
WGI, Medford Hillside, Mass., 485, also Am. Radio & Research Corp.
WGL, Philadelphia, Pa., Thos. F. J. Howlett.
WGM, Atlanta, Ga., 400 only, Atlanta Constitution.
WGR, Buffalo, N. Y., 485 also Federal Tel. & Teleg. Co.
WGV., New Orleans, La., Interstate Elec. Co. 485 also.
WGY, Schenectady, N. Y., 400 and 485 also General Elec. Co.
WHA, Madison, Wis., 485 also Univ. of Wis.
WHAA, Iowa City, Ia; 500 miles; 8:30 p m, Monday, Instruction; Tuesday, concert; Wednesday, popular lecture; Friday, University News; public lectures and concerts irregularly; State University of Iowa.
WHAB, Galveston, Texas, 300, 485, 600 also Clark W. Thompson (Fellman's Dry Goods Co.)
WHAC, Waterloo, Iowa, Cole Bros. Elec. Co.
WHAD, Milwaukee, Wis., 485 also; Marquette Univ.
WHAE, Sioux City, Iowa, Automotive Elec. Service Co.
WHAG, Cincinnati, Ohio, Univ. of Cincinnati.
WHAH, Joplin, Mo. 300 miles; Tuesday and Thursday nights 8 to 10; Hafer Supply Co.
WHAI, Davenport, Iowa, Radio Equip. & Mfg. Co.
WHAJ, Bluefield, W. Va., Bluefield Daily Telegraph and E. K. Kitts.
WHAK, Clarksburg, W. Va., Roberts Hdwe. Co.
WHAL, Lansing, Mich., Lansing Capitol News.
WHAM, Rochester, N. Y. 485 also; Daily—Weather report 2:40 p m; Organ 2:45, 5:00, 6:45; Orchestra 3:00, 7:00; Bed-time stories, Sport results, Business reports and market reports, the latter on 485 meters, 7:15 p m; Sunday—Radio Chapel Service, 3:15 p m; University of Rochester.
WHAO, Savannah, Ga., Frederick A. Hill; every evening 8 to 9; Saturday nights, 12:30 1:30 a. m.
WHAP, Decatur, Ill., Dewey L. Otta.
WHAQ, Washington, D. C., Semmes Motor Co.
WHAR, Atlantic City, N. J., Paramount Radio & Elec. Co.
WHAS, Louisville, Ky., Courier Journal and Louisville Times Co.
WHAV, Wilmington, Del., Wilmington Elec. Spec. Co.
WHAW, Tampa, Fla. 100 miles; 12 to 1, 4 to 5 p m, music; Pierce Electric Co.
WHX, Des Moines, Iowa; 300 miles; 5:45 p m to 6:15 p m Daily; 8:00 p m to 10 p m Wednesday evenings; Central Standard time; Iowa Radio Corp.
WHAY, Huntington, Ind., Huntington Press.
WHAZ, Troy, N. Y., 400 only, Rensselaer Polytechnic Inst.
WHB, Kansas City, Mo., 400 and 485 also Sweeney Auto & Tractor School
WHD, Morgantown, W. Va., W. Va. University.
WHK, Cleveland, Ohio, Warren R. Cox.
WHN, Ridgewood, N. Y., Times Printing & Pub. Co.
WHU, Toledo, Ohio, Wm. B. Duck Co.
WIAB, Rockford, Ill., Joslyn Automobile Co.
WIAC, Galveston, Texas, 485 also Galveston Tribune.
WIAD, Ocean City, N. J., Ocean City Yacht Club.
WIAE, Vinton, Iowa, Mrs. Robt. E. Zimmerman.
WIAF, New Orleans, La., Gustave A. De Cortin.
WJAG, Norfolk, Nebr: 485 also; 200 miles News and Markets 12:15, 3:30 and 5:30 p m. The Huse Publishing Co. The Norfolk Daily News.
WIAH, Newton, Iowa, Continental Radio & Mfg. Co.
WIAI, Springfield, Mo., Heer Stores Co.
WIAJ, Neenah. Wis., Fox River Valley Radio Supply Co.
WIAK, Omaha, Nebr.; 485, 7:45 a m Livestock receipts; 9:10 a m Livestock receipts and opening on hogs; 10:15 a m rainfall and temperature report and weather forecast for Nebraska and Iowa, Livestock market; 12 m cattle, hog and sheep market; 1:50 p m rainfall and temperature report and weather forecast for Nebraska and Iowa; market detail; 3:50 p m complete market reports and estimated receipts for next day; Daily Journal-Stockman.
WIAO, Milwaukee, Wis., School of Engineering.
WIAP, Springfield, Mass., Radio Development Corp.
WIAQ, Marion, Ind., Chronicle Pub. Co.
WIAR, Paducah, Ky., Musical 3:30 to 4 p. m. and 7 to 8 p. m. except Sundays. Paducah Evening Sun; Albert Bennett, operator.
WIAS, Burlington, Iowa, Hawk-Eye Home Elec. Co.
WIAT, Tarkio, Mo., Leon T. Noel.
WIAU, Le Mars, Iowa, Am. Trust & Savings Bank.
WIAV, Binghamton, N. Y., N. Y. Radio Lab.
WIAW, Saginaw, Mich., Saginaw Radio & Elec. Co.
WIAY, Washington, D. C., Woodword & Lothrop.
WIAZ, Miami, Fla., Elec. Supply Sales Co.
WIK, McKeesport, Pa., K. & L. Elec. Shop.
WIL, Washington, D. C., Continental Elec. Supply Co.
WIP, Philadelphia, Pa., Gimbel Bros.
WIZ, Cincinnati, Ohio, 485 also Cino Radio Mfg. Co.
WJAB, Lincoln, Nebr., American Radio Co.
WJAD, Waco, Texas, 485 also Jackson's Radio Engrng. Lab.
WJAF, Muncie, Ind; 1800 miles; 7:30 to 8 Monday, Wednesday, Friday evening, music; 6:30 to 7 p m Saturday, music; 3:30 to 4 every afternoon, News; 10:30 to 12 M Sundays, Church service. Smith Electric-Muncie Press.
WJAJ, Dayton, Ohio 200 miles; Sunday 8:40, 9:15 Religious; Wednesday 9:15, 9:45 Entertainment; Friday 9:15 to 9:45 Entertainment. Y. M. C. A.
WJAK, Stockdale, Ohio, 485 also White Radio Lab.
WJAM, Cedar Rapids, Iowa, Evening Gazette.
WJAN, Peoria, Ill. Daily except Sunday; 9:15 a. m. official weather (485); 11:30 a. m. weather and markets (360) 1:30 p. m. market close (360). Tuesday, Thursday and Saturdays: concerts at 9:15 p. m. Peoria Star.
WJAP, Duluth, Minn. 1500 miles; Sunday 11 a m, 12:30 p m Church Service and organ recital; First Methodist Church, Rev. Chas. N. Pace, Pastor. Monday 8: p m to 9 p m, musical; Thursday 8 p m to 9 p m, musical; Kelley Duluth Co.
WJAQ, Topeka, Kans., Capper Publications.
WJAR, Providence, R. I., The Outlet Co., J. Samuels & Bros.
WJAS, Pittsburgh, Pa., Pittsburgh Radio Supply House.
WJAT, Marshall, Mo., Kelloy-Vawter Jewelry Co.
WJAX, Cleveland, Ohio, 485 also Union Trust Co.
WJAZ, Chicago, Ill., Chicago Radio Lab.
WJD, Granville, O; 100 miles, music by Denison Conservatory, educational lectures and discussions; Denison University.
WJH, Washington, D. C., White & Boyer Co.
WJX, New York, N. Y., De Forest Radio Telephone & Teleg. Co.
WJZ, Newark, N. J., 485 also Westinghouse Elec. & Mfg. Co.
WKAA, Cedar Rapids, Iowa, 485 also H. F. Paar.
WKAC, Lincoln, Neb., Star Pub. Co.
WKAF, Wichita Falls, Texas, W. S. Radio Supply Co.
WKAH, West Palm Beach, Fla., Planet Radio Co.
WKAK, Okemah, Okla., Okfuskee County News.
WKAL, Orango, Texas, Gray & Gray.
WKAN, Montgomery, Ala., Alabama Radio Mfg. Co.
WKAP, Cranston, R. I., Dutee W. Flint.

(Continued on next page.)

Corrected List of U.S. Stations Alphabetically by Call Signals

WKAQ, San Juan, Porto Rico, Radio Corp. of Porto Rico.
WKAR, East Lansing, Mich., Mich. Agrl. College.
WKAS, Springfield, Mo., L. E. Lines Music Co.
WKAV, Laconia, N. H., Laconia Radio Club.
WKAW, Beloit, Wisc., Turner Cycle Co.
WKAX, Bridgeport, Conn., Wm. A. MacFarlane.
WKAY, Gainesville, Ga., Brenau College.
WKC, Baltimore, Md., Jos. M. Zamoiski Co.
WKN, Memphis, Tenn., Riechman-Croshy Co.
WKY, Oklahoma City, Okla., 485 also Oklahoma Radio Shop.
WLZ, Fairfield, Ohio, U. S. Army.
WLAC, Raleigh, N. C., N. C. State College.
WLAG, Minneapolis, Minn., Cutting & Walsh Radio Corp.
WLAH, Syracuse, N. Y., Samuel Woodworth.
WLAJ, Waco, Texas, 485 also Waco Elec. Supply Co.
WLAK, Bellows Falls, Vt., Vermont Farm Machine Co.
WLAL, Tulsa, Okla., Tulsa Radio Co.
WLAM, Springfield, Ohio, Morrow Radio Co.
WLAN, Houlton, Me., Putnam Hdwe. Co.
WLAP, Louisville, Ky., W. V. Jordan.
WLAQ, Kalamazoo, Mich., A. E. Schilling.
WLAS, Hutchinson, Kans., Hutchinson Grain Radio Co.
WLAT, Burlington, Iowa, Radio Specialty Co.
WLAV, Pensacola, Fla.; daily musical program, 8 to 9 p m; The Electric Shop.
WLAW, New York, N. Y., New York Police Dept.
WLAX, Greencastle, Ind., Greencastle Community Broadcasting Station.
WLAY, Fairhanks, Alaska, Northern Commercial Co.
WLAZ, Warren, Ohio, Hutton & Jones Elec. Co.
WLB, Minneapolis, Minn., Univ. of Minn.
WLK, Indianapolis, Ind., 485 also Hamilton Mfg. Co.
WLW, Cincinnati, Ohio, 485 also Crosley Mfg. Co.
WMA, Anderson, Ind., Arrow Radio Lab.
WMAB, Oklahoma City, Okla., Radio Supply Co.
WMAC, Cozenovia, N. Y, 750 miles; music 11: p m; Cleve B. Meredith.
WMAD, Rockport, Mo., Atchinson County Mail.
WMAE, Dartmouth, Mass., Round Hills Radio Corp.
WMAG, Liberal, Kans., Tucker Elec. Co.
WMAH, Lincoln, Nebr., General Supply Co.
WMAJ, Kansas City, Mo., 485 also Drovers Telegram.
WMAK, Lockport, N. Y., Norton Labs.
WMAL, Trenton, N. J, 100 miles; 7:30 to 9 p m, Mondays and Thursdays, musical programs, lectures etc; Trenton Hardware Co.
WMAM, Beaumont, Texas, Beaumont Radio Equip. Co.
WMAN, Columbus, Ohio, First Baptist Church.
WMAP, Easton, Pa., Utility Battery Service.
WMAQ, Fair Store Building, Chicago; 4:35 to 5 p m, daily; 7 to 7:30 p m, Monday, Wednesday, Friday and Saturday; 7 to 8 p m, Tuesday and Thursday; 9:15 to 10 p m daily; Chicago Daily News and Fair Department Store.
WMAR, Waterloo, Iowa, Waterloo Elec. Supply Co.
WMAT, Duluth, Minn., Paramount Radio Corp.
WMAV, Auburn, Ala., Polytechnic Inst.
WMAW, Wahpeton, N. D., Wahpeton Elec. Co.
WMAX, Ann Arbor, Mich., K. & K. Radio Supply Co.
WMAY, St. Louis, Mo., 600 miles; Religious services Sunday, 11 a m and 8 p m; Tuesday at 7 p m; Kingshighway Presbyterian Church.
WMAZ, Macon, Ga., Mercer University.
WMB, Auburn, Maine, Auburn Elec. Co.
WMH, Cincinnati, Ohio, 485 also Precision Equipment Co.
WMU, Washington, D. C., Doubleday-Hill Electric Co.
WNAB, Bowling Green, Ky., Park City Daily News.
WNAC, Boston, Mass.: Monday 4 to 5 p. m. (silent at night) Tuesday 4 to 5 p. m. and 7 to 8:30 p. m. Wednesday 4 to 5 p. m. 9:30 to 11 p. m. Thursday 4 to 5 and 7 to 8:30 p. m. Friday 4 to 5 and 8 to 9:30 p. m. Saturday 4 to 5 and 9:30 to 11 p. m. The Shepard Stores; J. J. Fanning, announcer; Samuel Curtis, operator.
WNAO, Norman, Okla., Okla. Radio Engineering Co.
WNAH, Manhattan, Kans., Manhattan Radio Supply Co.
WNAL, Omaha, Nebr., R. J. Rockwell.
WNAN, Syracuse, N. Y., Syracuse Radio Telephone Co.
WNAP, Springfield, Ohio, Wittenberg College.
WNAQ, Charleston, S. C., Charleston Radio Elec. Co.
WNAS, Austin, Texas, Radio Corp.
WNAT, Philadelphia, Pa. 1000 miles; Talks, Radio information, music, Chapel Service. Wednesday 7:30 p m; Saturday 7:30 p m; Sunday 2:30 and 4:30; Every day 12:15, 1 p m. Lennig Bros. Co.
WNAV, Knoxville, Tenn., People's Tel. and Tel. Co.
WNAY, Baltimore, Md., Shipowners' Radio Service.
WNAX, Yankton, S. D., Dakota Radio Apparatus Co.
WNAW, Fortress Monroe, Va., Henry Kunzman.
WNJ, Albany, N. Y., Shotton Radio Mfg. Co., Inc.
WNO, Jersey City, N. J., Wireless Telephone Co. of Hudson Co., N. J.
WOAQ, Omaha, Nebr. 100 miles; Woodmen of the World.
WOAA, Ardmore, Okla., Dr. Walter Hardy.
WOAC, Lima, Ohio, Maus Radio Co.
WOAE, Fremont, Nebr., Medland College.
WOAF, Tyler, Texas, Tyler Commercial College.
WOAH, Charleston, S. C., Palmetto Radio Corp.
WOAI, San Antonio, Tex. 485 also; daily except Sunday 10:30, 12:15, 3, 6 p m, News, market, weather reports; Wednesday, Concert 7:30 to 8:30 p m; Sunday evening concert 9:30 to 10:30 p m; Southern Equipment Co. and The Evening News and The Express.
WOAJ, Parsons, Kans., Erving's Electrical Co.
WOAK, Frankfort, Ky., Collins Hardware Co.
WOAL, Webster Groves, Mo., Wm. E. Woods.
WOAN, Lawrenceburg, Tenn., James D. Vaughan.
WOAR, Kenosha, Wis., Henry P. Lundskow.
WOAS, Middleton, Conn., Bailey's Radio Shop.
WOAT, Wilmington, Del., Boyd Martell Hamp.
WOAU, Evansville, Ind., Sowder Bolling Piano Co.
WOAV, Erie, Pa., Pa. Nat'l Guard.
WOAX, Trenton, N. J., Franklin J. Wolff.
WOAY, Birmingham, Ala., John W. Wilder.
WOAQ, Portsmouth, Va., Portsmouth Radio Ass'n.
WOAW, Omaha, Neb., 100 miles, Woodmen of the World.
WOAZ, Stanford, Texas, Penick Hughes Co.
WOC, Davenport, Ia, 485 meters; time signals, 10:55 a m; weather 11 a m; 360 meters, 11:05 opening market quotations, agriograms; 12:00 noon, chimes concert; 2:00 p m, closing stocks and markets; 3:30 p m, educational talk; 5:45 p m chimes concert; 6:35, sandman's visit; 7:00 musical program; 8 p m, lecture; Sundays, religious and musical and religious features, 9 a m to 10 p m; Palmer's School of Chiropractic.
WOI, Ames, Ia., 485 also Iowa Stats College.
WOK, Pine Bluff, Ark., concerts Tuesday and Friday evenings beginning at 9; Sundays, song service and sermons from churches at 11 a. m. and 7:30 p. m., Arkansas Light & Power Co.
WOO, Philadelphia, Pa., 400 and 485 also, John Wanamaker.
WOQ, Kansas City, Mo., 485 also Western Radio Co.
WOR, Newark, N. J., 400 only, L. Bamberger & Co.
WOS, Jefferson City, Mo. 485 also; first fifteen minutes of every hour from 8: a m to 2: p m; 5 p m, markets and music, 360 meters; Monday, Wednesday, Friday nights, 8 to 9:30 concerts; no Sunday program; Missouri State Marketing Bureau.
WOV, Omaha, Nebr., R. B. Howell.
WOU, Omaha, Nebr., Metropolitan Utilities.
WOZ, Richmond, Ind., 485 also Palladium Printing Co.
WPA, Fort Worth, Texas, 485 also Fort Wortb Record.
WPAA, Wahoo, Neb., Anderson & Webster Elec. Co.
WPAB, State College, Pa.
WPAC, Okmuigee, Okla., Donaldson Radio Co.
WPAD, Chicago, Ill., Wieboldt & Co.
WPAF, Council Bluffs, Iowa, Peterson's Radio Co.
WPAG, Independence, Mo., Central Radio Co.
WPAH, Waupaca, Wis., Wisconsin Dept. of Markets.
WPAJ, New Haven, Conn., Doolittle Radio Corp.
WPAK, Fargo, N. D., North Dakota Agricultural College.
WPAL, Columbus, Ohio, Superior Radio & Tel. Equip. Co.
WPAM, Topeka, Kans., Awerbach & Guettel.
WPAP, Winchester, Ky., Theo. D. Phillips.
WPAQ, Frosthurg, Md., General Sales & Eng. Co.
WPAQ, Wilmington, Del., Radio Installation Co., Inc.
WPAR, Beloit, Kans., R. A. Ward.
WPAS, Amsterdam, N. Y., J. & M. Electric Co.
WPAT, El Paso, Texas, St. Patrick's Cathedral.
WPAU, Moorhead, Minn., Concordia College.
WPAV, Laurium, Mich., Paul Tinetti & Sons.
WPAX, Thomasville, Ga., S. W. Radio Co., J. R. Shumate, Jr.
WPAY, Bangor, Me., Bangor Radio Laboratory.
WPAZ, Charleston, W. Va., Dr. John R. Koch.
WPE, Independence, Mo.
WPG, New Lebanon, Ohio 1500 miles; Program exclusive for the farmer; 12 to 12:15 p m News Flashes; 6 to 6:30 p m, News, Markets; 8 to 9:45 Monday and Wednesday; music and farm program. Nushawg Poultry Farm.
WPI, Clearfield, Pa., Elec. Supply Co.
WPM, Washington, D. C., Thos. J. Williams, Inc.
WPO, Memphis, Tenn., United Equip. Co.
WSAC, Clemson College, S. C.; Clemson Agriculture College.
WQAA, Parkersburg, Pa. 1500 miles; 10:30 p m every evening. Horace A. Beale, Jr.
WQAB, Springfield, Mo., Southwest Missouri State Teachers' College.
WQAC, Amarillo, Texas, E. B. Gish.
WQAO, Waterbury, Conn., Whitall Electric Co.
WQAE, Springfield, Vt., Moore Radio News Station.
WQAF, Sandusky, Ohio, Sandusky Register.
WQAH, Lexington, Ky., Brock-Anderson Elect. Eng Co.
WQAJ, Ann Arbor, Mich., Ann Arbor Times-News.
WQAK, Dubuque, Iowa, Appel-Higley Elec. Co.
WQAL, Mattoon, Ill., Cole County Tel. and Tel. Co.
WQAM, Miami, Fla., Electrical Equipment Co.
WQAO, New York, N. Y., Calvary Baptist Church.
WQAP, Lincoln, Nebr., Am. Radio Co.
WQAQ, Abilene, Texas, West Texas Radio Co.
WQAR, Muncie, Ind., Press Puhilshing Co.
WQAS, Lowell, Mass.; Prince-Waller Co.
WQAT, Westhampton, Va.; Radio Equipment Corp.
WQAV, Greenville, S. C.; Huntington & Guerry, Inc.
WQAW, Scranton, Pa., Scranton Times.
WQAW, Washington, D. C.; Catholic University.
WQAY, Hastings, Nebr., Gaston Music & Furniture Co.
WQX, Chicago, Ill., Riverview Park, Walter A. Kuehl.
WRAA, Houston, Texas, Rice Institute.
WRAB, Savannah, Ga.; Savannah Board of Public Education.
WRAC, Mayville, N. D., State Normal School.
WRAO, Marion, Kansas. Taylor Radio Shop.
WRAJ, Pittshurgb, Penn., M. H. Pickering Co.
WRAM, Carthage, Ill., Robert E. Compton & Carthage College.
WRAM, Galesburg, Ill., Lombard College.
WRAN, Waterloo, Iowa, Black Hawk Elec. Co.
WRAO, St. Louis, Mo., Radio Service Co.
WRAU, Amarillo, Texas, Daily News.
WRAV, Yellow Springs, O., Antioch College.
WRAY, Scranton, Pa., Radio Sales Corp.
WRK, Hamilton, Ohio, Doron Bros. Elec. Co.
WRL, Schenectady, N. Y., Union College.
WRM, Urbana, Ill., Univ. of Ill.
WRP, Camden, N. J., Federal Inst. of Radio Telg.
WRR, Dallas, Texas, 485 also City of Dallas, Police and Fire Signal Dept.
WRW, Tarrytown, N. Y., Koenig Bros., Tarrytown Radio Research Lab.
WSAA, Marietta, O., B. S. Sprague Electric Co.
WSAB, Cape Girardeau, Mo., Southeast Mo. State College.
WSAC, Clemson College, S. C.; Clemson Agricultural College.
WSAH, Chicago, Ill.; A. G. Leonard, Jr.
WSAJ, Grove City, Pa., Grove City College.
WSAL, Brookville, Ind.; Franklin Electric Co.
WSAS, Lincoln, Nebr., State of Nebr.
WSAT, Plainview, Texas, The Plainview Electric Co.
WSAV, Houston, Texas, C. W. Vick Radio Const'n Co.
WSB, Atlanta, Ga., 400 and 485 Atlanta Journal.
WSL, Utica, N. Y., J. & M. Elec. Co.
WSY, Birmingham, Ala., Alabama Power Co.
WTAC, Johnstown, Pa., Penn. Traffic Co.
WTAS, Elgin, Ill.; George D. Carpenter.
WTAU, Tecumseh, Neb., Ruegy Battery & Elec. Co.
WTAW, College Station, Texas, Agricultural and Mechanical College of Texas.
WTG, Manhattan, Texas, Kans. State Agri. College.
WTP, Bay City, Mich., Ra-Do Corp.
WVP, New York, N. Y. Signal Corps, U. S. Army.
WWAC, Waco, Tex; 3000 miles; Weather forecasts 11 a m daily; musical concerts, daily, 1:30 p m and on Wednesday and Saturday evenings at 8; Sanger Bros.
WWAO, Philadelphia, Pa., Wright & Wright, Inc.
WWAX, Laredo, Texas, Worman Bros.
WWAY, Chicago, Ill.; Marigold Gardens.
WWB, Canton, Ohio, Daily News Printing Co.
WWI, Dearborn, Mich., Ford Motor Co.
WWJ, Detroit, Mich., 400 485, Evening News.
WWL, New Orleans, La., Loyola Univ.
WWX, Washington, D. C., Post Office Dept.
2XAI, Newark, N. J., Westinghouse Elec. & Mfg. Co.
2XI, New York City, A. T. & T. Co.
2XJ, Deal Beach, N. J., Amer. Tel. & Telg. Co.
3XW, Parkersburg, Pa., Horace A. Beale, Jr.
3YN, Washington, D. C., Nat'l Radio Inst.
9ARU, Louisville, Ky., Darrell A. Downard.

WGY Vesper Services

Every Sunday afternoon a little group of people assembles in the radio studio of WGY in the midst of the towering factory buildings of the General Electric Company at Schenectady and conducts a vesper service including organ selections, hymns, scripture reading and sermon. The group in the studio is small but many thousands in city and country participate in the devotions.

These services not only enter many homes but they are multiplied by means of receiving sets and loud speakers and made to furnish the religious inspiration of other gatherings in distant places. For example the Railroad Y. M. C. A. at Oneonta, N. Y., no longer arranges vor a special afternoon service but instead receives WGY and according to letter from the general secretary, A. C. Lange "These services come through very clear and are enjoyed by all who attend."

Charles J. Clark, a merchant at Holland Patent, N. Y., informed WGY that the Baptist Church at that place was closed recently on account of the scarcity of coal. He invited the congregation to meet with him in his home and they listened to the service broadcast by WGY.

Amateurs Increase

There is still great interest in amateur radio telegraphy. This fact is shown by the increase in general and restricted amateur licenses issued by the Department of Commerce since January 1, which number 601. On January 1, there were 17,102 amateur licenses in effect, and on March 1, there were 17,703.

These figures do not include 617 other non-commercial stations, which comprise 134 technical and training school stations, 297 experimental and 186 special amateur stations.

The distribution of special amateur licenses by districts is as follows, showing the Chicago District, including northern peninsula of Michigan, Wisconsin, Illinois, Kentucky, Indiana, Minnesota, Iowa, Missouri, North, and South Dakota, Nebraska, Kansas and Colorado first:

District	Headquarters	Total Mar. 1
1	Boston	2,490
2	New York	2,589
3	Baltimore	1,919
4	Norfolk	420
5	New Orleans	825
6	San Francisco	2,019
7	Seattle	863
8	Detroit	2,749
9	Chicago	3,729
Total, special amateurs		17,703

Amateurs Suspended

The Department of Commerce has recently suspended the licenses of a number of amateur operators for violation of the act of August 13, 1912, section 4, regulations 3, 4, and 15. Similar action may be taken against any other operator reported for violation of the radio law. The above-cited regulations read as follows:

Regulation third. At all stations if the sending apparatus, to be referred to hereinafter as the "transmitter," is of such a character that the energy is radiated in two or more wave lengths, more or less sharpely defined, as indicated by a sensitive wave meter, the energy in no one of the lesser waves shall exceed ten per centum of that in the greatest.

Regulation fourth. At all stations the logarithmic decrement per complete oscillation in the wave trains emitted by the transmitter shall not exceed two-tenths, except when sending distress signals or signals and messages relating thereto.

Regulation fifteenth. No private or commercial station not engaged in the transaction of bona fide commercial business by radio communication or in experimentation in connection with the development and manufacture of radio apparatus for commercial purposes shall use a transmitting wave length exceeding two hundred meters, or a transformer imput exceeding one kilowatt, except by special authority of the Secretary of Commerce contained in the license of the station: *Provided*, That the owner or operator of a station of the character mentioned in this regulation shall not be liable for a violation of the requirements of the third or fourth regulations to the penalties of one hundred dollars or twenty-five dollars, respectively, provided in this section unless the person maintaining or operating such station shall have been notified in writing that the said transmitter has been found, upon tests conducted by the Government, to be so adjusted as to violate the said third and fourth regulations, and opportunity has been given to said owner or operator to adjust said transmitter in conformity with said regulations.

AMERICAN

Free Hand Book of Radio Hookups

We will send you free a useful handbook containing 25 easily understood diagrams of tested radio hookups. Just enclose 2c stamp for postage.

We will appreciate it as a favor if you will mention the name and address of the radio dealer with whom you prefer to trade, and whether he now carries All-American Audio and Radio Amplifying Transformers.

RAULAND MFG. CO.
35 So. Dearborn St., Chicago, Ill.

Radio Needs Trained Men

Radio is sweeping the country like wild fire. Thousands of dollars are being spent for expensive outfits. RADIO EXPERTS are needed everywhere to keep this equipment in order and to sell and install new outfits.

Be a Radio Expert

I will train you quickly and easily in your spare time, to become a RADIO EXPERT so you can install, construct, repair and sell Radio equipment. I am a **Graduate Electrical Engineer** and from actual experience I will give you exactly what you must know to make the really **big money in radio.**

FREE My Consultation Service to you is FREE. This outside help which I gladly give you is, in itself, worth more than the small cost of the Complete Course.

START NOW

Don't let others beat you to the big money. **Start now** and within a few weeks' time I will train you at home, at an amazingly low cost, to become a RADIO EXPERT. Write for **"Radio Facts"** sent **free** without obligation.

A. G. MOHAUPT, Electrical Engineer
American Electrical Association
Dept 284 4511 Ravenswood Ave, Chicago

WRITE TODAY

Reinartz Book FREE

Reinartz Radio Book with Hook-ups—best book on best circuit—written and illustrated by Frank D. Pearne. If you want one free sign the coupon below and get the book and one year's subscription to Radio Age for $2.00.

RADIO AGE,
64 West Randolph St.,
CHICAGO.

Please send me FREE one of your Reinartz Radio Books and send me Radio Age for one year. I want to take advantage of this Special April Offer. I enclose $2.00.

Name.....

City.....

Street and Number.....

Honolulu Tells Radio Age of Wireless in Hawaii

HERE is a letter that fairly takes the breath away.

The greatest daily newspaper in Hawaii is the Honolulu Star-Bulletin. The Star-Bulletin operates the broadcasting station KDYX, which is a regular he-man outfit.

If you think you are entitled to a bit of a thrill when you get a Canadian station, or one perhaps two-thirds of the way across the continent, think of the kick the Star-Bulletin must get out of listening to the Kansas City Nighthawk and talking to the South Sea Islands. Not only listens to America but *re-broadcasts* the programmes for radio fans in strange island communities and on distant shores.

In publishing this letter Radio Age makes grateful acknowledgment and extends best wishes to the brothers out in the Pacific.

Here is the letter:

Editor Radio Age:

"KDYX, the station of the Honolulu Star-Bulletin was recently successful in re-broadcasting portions of the special programs broadcast by KHJ (the Los Angeles Times); KFDB (The Mercantile Trust Co., San Francisco) and KGW (the Portland Oregonian), on Sunday morning, January 21, between the hours of 1 and 3 a. m. Pacific Coast time. Because of the difference in time it was still Saturday night (10:30 p. m.) when their concerts were received here.

"Through the cooperation of the Radio Corporation of America who loaned their special wires or "tone-channels" from their receiving station at Koko Head, about ten miles from Honolulu, and the Mutual Telephone Company, who arranged lines from the downtown office of the Radio Corporation to the broadcasting rooms of the Star-Bulletin, we were able to put over the first (to my knowledge) re-broadcasting of stations over 2,000 miles distant.

"Receiving Engineer Corey at Koko Head station, using a receiving set the circuits of which he has developed himself, and which is privately owned, succeeded in first tuning in KHJ (the Los Angeles Times) and after boosting the signal with two steps audio frequency fed it through a telephone transformer into the tone channels and thence through a roundabout circuit to the Star-Bulletin, where the signal was further amplified and fed into KDX transmitter, operating on 360 meters.

"With the exception of difficulties caused by "static" and interference from ships close to Koko Head, the concert was re-broadcast with perfect clarity and the applause of those in the studio at KHJ following each number was plainly audible in the re-broadcast. KFDB (Telegraph Hill, San Francisco) was next tuned in and the announcer was heard, also part of an address given eastern amateurs; KGW (the Portland Oregonian) was tried and from them the best signal for re-broadcast was received. Orchestra numbers from this station were received and re-broadcast with absolute clarity and the conductor could be heard striking the music rack or marking time by some such means at the beginning of their selections.

"Frequent changes were made back to the other stations so that local fans—even those with the most simple crystal detectors—were able to hear representative parts of the program from these excellent stations quite as if they had been within ten miles of the stations themselves instead of over 2,000 miles away.

"It is hoped in the near future to re-broadcast a portion of the program from the Kansas City Star and the Sweeney Automobile School at Kansas City.

"I hope to soon be able to send you a diagram of Engineer Corey's receiving set which employs three circuits and shunt traps for other interfering waves as well as two tuned antennas.

"Radio Age is a welcome visitor at KDYX and I notice in your January issue several items on long distance receiving by local listeners.

"I might add that British Samoa heard our re-broadcast signal quite clearly making the original concerts heard over an area of four thousand miles of the Pacific.

"Sincerely yours,

"C. B. ROSS,

"Manager, Radio KDYX.

DR. HUDSON MAXIM, the distinguished scientist, recently made an address from Station WSY, Birmingham, Ala., on the question "Shall Man or Bug Inhabit the Earth?" The picture shows, left to right, Mrs. Thomas W. Martin, Mr. Thomas W. Martin, President of the Alabama Power Co.; Dr. Maxim and Mrs. Maxim. The studio of WSY is extremely well appointed and the station is a popular one with the fans.

Europe Gets W O R

The Bamberger broadcasting station, WOR, of Newark, N. J., succeeded in transmitting a complete classical concert to Europe in February. The hour selected was midnight of February 23-24, Eastern time, that hour being chosen because the transmission conditions over the Atlantic are best at that time.

Miss Edith Bennett was chosen from a long list of American and European concert stars to sing into the microphone for the reason that Miss Bennett's voice was found to be peculiarly adapted to radio-phone transmission. The result proved that the jury of radio musical experts were competent.

The entire country was watching for reports as to how the test succeeded and there was great gratification when the cables brought the news that Europe had listened in and had been vastly entertained.

One of the most interesting reports on the successful experiment came from Lichterfeld, Germany, whence it was reported that Seehof, an experimental wireless station, had picked up Miss Bennett's songs. By one of those freaks of difference in time the Seehof people apparently heard the singer six hours after she sang, having picked her voice up at six on the morning of Saturday, February 24. Which proved that Seehof is six hours ahead of Newark, by suntime.

Both the vocal and instrumental tones were perfectly audible. The transmission is regarded as remarkable since the broadcasting station operated on a 400-meter wave length, the same as is commonly used for nearby American listeners. Eight high vacuum amplifiers were used in receiving, but only an ordinary antennae eight meters high.

Lichterfield is a suburb of Berlin. Reports were received in New York that receiving stations in England and France and far inland cities of the United States also heard Miss Bennett singing in Newark.

The program was sung in Italian, French and English. It was made up entirely of selections by eminent French, Italian, English and American composers and most of them were among the auditors of the first inter-continental radio recital, here and abroad.

Several of the big Continental newspapers, including the Paris N. Y. Herald, the Antwerp Neptune, the Geneva Courrier and the Stockholm Svenska Dagbladt, made arrangements to receive Miss Bennett's concert for assembled audiences. Practically every radio club over there did likewise and, of course, almost every individual radio fan abroad made a serious attempt to listen-in.

WOR had been heard clearly in France, Italy, Belgium, England, Scotland and Sweden on a dozen previous occasions.

Beware of Thieves!

Fake radio inspectors have been gaining admission to Chicago houses on pretense that they wish to see if the receiving sets are properly connected, etc. They take advantage of the opportunity to steal valuable radio accessories and other property.

Health Broadcasting

On the first anniversary of its broadcasting, the Public Health Service announced that since its inauguration a year ago on NOF, the service has grown until today ten stations in the nine states and one in Canada are carrying its educational talks. It is unique, in that it is the only national health radio service in the world. Its messages are not only heard by thousands, but are being used extensively in the foreign language press in both America and Europe. For the first time, a call is being made for replies from listeners-in to determine exactly how extensive is its scope and how its 102 broadcasts are received.

More Broadcasters

Washington, D. C.—An increase of eleven broadcasting stations was shown on the records of the Department of Commerce during the month of February. On the first of February, there were 570 stations licensed to broadcast entertainment data and news while on March 3, there were 581 broadcasters operating.

During February, twenty-four new licenses were issued to broadcast, but thirteen old stations ceased to function, Of the total stations transmitting entertainment today, twenty-eight are Class B stations operating on 400 meters, the balance being on 360.

Make Your Crystal Set 100% Efficient by Using

MPM

"Million Point Mineral"

The WORLD'S GREATEST RADIO CRYSTAL

THE discovery of M. P. M. has revolutionized the possibilities of ordinary crystal sets. Concerts have been clearly heard over 1000 miles. M. P. M. is super-sensitive—reproducing from every point on its surface. It increases audibility as well as radius and makes the purchase of an expensive tube set unnecessary.

Send 25c and name of your Radio Dealer for a sample M. P. M. crystal—concert tested and guaranteed.

DEALERS: Write today for our attractive sales proposition.

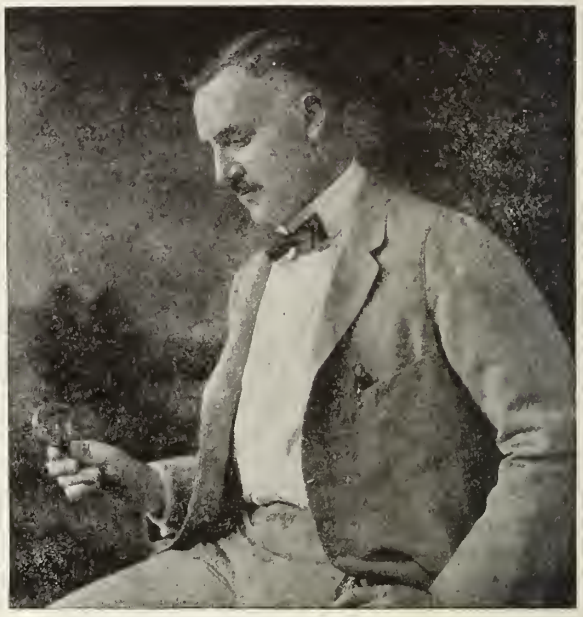
M. P. M. SALES COMPANY

Dept. RA

247 S. Central Ave. Los Angeles, Calif.

Perfect Broadcasting Now Possible

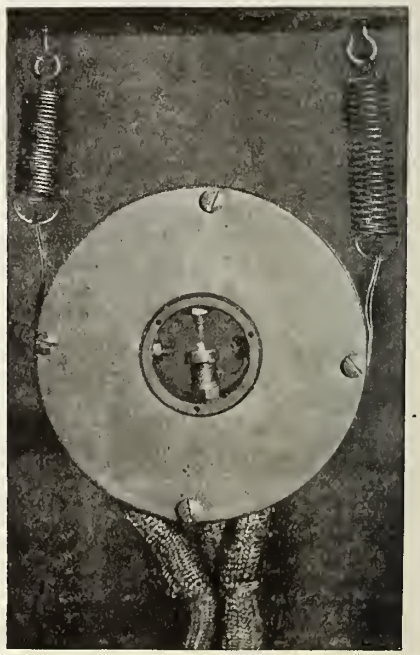
Westinghouse Engineer Solves Transmitter Problem



At right — Dr. Thomas, the inventor of the Glow discharge microphone.

Below — Close up view of the glow discharge transmitter.

At left—Artist singing into the glow transmitter at KDKA.



MILLIONS of radio fans will be benefited by a new radio transmitter invented by Dr. Phillips Thomas, research engineer of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. The new transmitter makes possible the broadcasting of music and other sounds exactly as produced. It has been used at the Westinghouse broadcasting station KDKA within the past few months, which explains the clarity and strength of this station's signals.

The basis of Dr. Thomas's invention is the elimination of the diaphragm now used in all transmitters in practical service. This diaphragm consists of a thin disk of metal or other substance and operates by being vibrated by the sound waves which strike it. But because of its inherent inertia, no material diaphragm is capable of vibrating in perfect sympathy with the entire range of audible sounds. If it can transmit low notes successfully, it will fail on high notes; and vice versa. The ordinary diaphragm is designed with reference to the middle register, and it therefore does not transmit extremely high and extremely low notes satisfactorily. The piano is a case in point. The radio audience hears the highest notes as a series of clicks and the very bass notes as a roar.

In the Thomas transmitter, a minute electrical discharge takes the place of the mechanical disk. This discharge flows between two points, separated by a very small fraction of an inch. It is affected by sound waves, just like the diaphragm, but being non-material and having no perceptible inertia, it responds equally well to all vibrations. Hence music broadcasted by means of it is transmitted in all its original purity.

Dr. Thomas has recently been experimenting with his transmitter at the Westinghouse Pittsburgh Station, KDKA. Listeners all over the country have noticed from time to time the great improvement in the quality of the voice of this station, but have naturally been unaware of the cause. Within the near future, all Westinghouse stations will be regularly equipped with this device, and the art of broadcasting will take another step forward.

In appearances, the Thomas transmitter resembles a large watch, with the front and back covered by wire gauze. On looking into it, a point of light can be seen, caused by the flow of the electric energy against one of the terminals. From this fact, it is called the Glow Discharge transmitter.

Send $1.00 to Radio Age, 64 Randolph Street, Chicago, and receive this middle-west radio periodical for six months. Regular subscription price is $2.50 a year.

How WDAP Made History

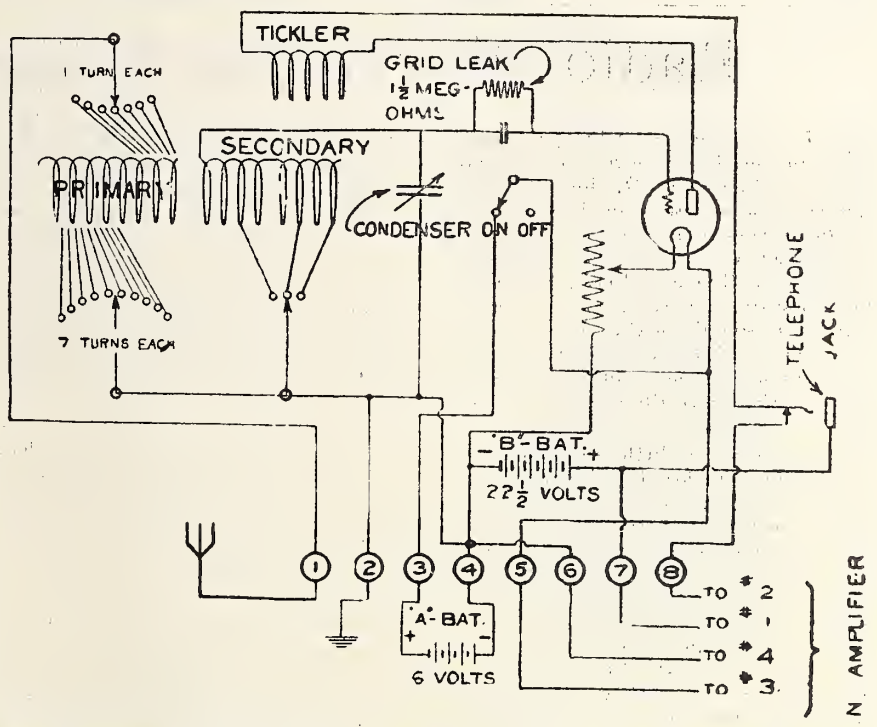
Following is an interesting account of a recent broadcasting achievement sent out by the Drake Hotel Station WDAP, the official broadcasting station of the Chicago Board of Trade.

NOT so long ago, Alexander Graham Bell appeared with his newly discovered telephone, on a stage in Philadelphia. The audience was made up of "doubting Thomases." It was hard to believe the rumors that had swept the country, of the strange and mysterious device that would enable one man to speak over a wire to another. And even after the test, they would not believe that Mr. Bell was heard a few blocks away, through that peculiar looking device he called a "telephone," until affidavits were produced by reputable persons who heard with their own ears.

Then, with the telephone. The other day, with radio. When Thorne Donnelley and Elliot Jenkins, owners of the Drake Hotel broadcasting station, the official broadcasting station of the Chicago Board of Trade, ventured the opinion that messages from the Drake could be heard in mid-ocean, on a prearranged schedule with a liner, their friends looked dubious. They were kind, of course, but—. A test was suggested. Mr. Donnelley thought of trying to reach the speeding S. S. Berengaria, which was due to leave New York harbor, and would clear 600 miles of watery waste every day. Well, they set about to give a demonstration, and like Mr. Bell saw to it that good and sufficient evidence of the facts was forthcoming.

On the S. S Berengaria which sailed January 30th, Miss Florence McDonald had installed a standard Zenith receiving set—a set just like every other that is made by the Chicago Radio Laboratory. From January 30th to February 4th, every day at appointed hours, both early and late in the evening, messages were flashed across the sky by Thorne Donnelley, the actual voice being transmitted, heard, and recognized aboard the Berengaria, which was speeding on its way to France. Each time an erroneous statement regarding the length of the Berengaria would be made (newspaper men picked the number haphazard out of a hat a few moments before the broadcasting), and each time came back the answer from the Berengaria giving the incorrect length as well as the correct length, now 250 miles out, then 725 miles out, again 1286 miles out, again 1824 miles out, and so on until the maximum distance was reached.

This was the first successful attempt to reach a voyaging ship from an inland station, on a predetermined schedule. No special tubes were used by the Drake Broadcasting Station. No special tubes were used in the Zenith receiving set. Out of a little bantering among friends sprouted an idea, only vague at first but soon developed definitely, finally into a reality that gives the Drake Broadcasting Station WDAP, and the Zenith, the distinction of having made important history in the field of radio.



Wiring Diagram of Zenith Set Used Aboard the S. S. Berengaria. Furnished Through the Courtesy of Chicago Radio Laboratory

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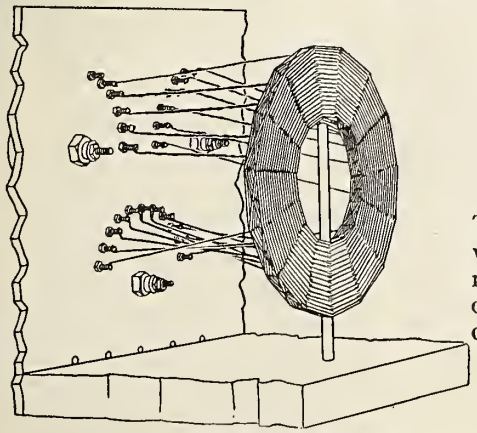

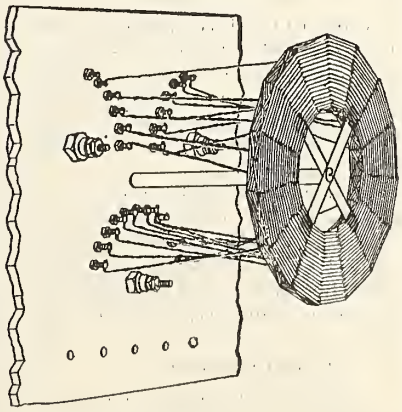

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Ask also for Pfanstiehl Honeycomb Coils.

PFANSTIEHL RADIO SERVICE COMPANY

HIGHLAND PARK ILLINOIS

Radio Diverts Big Rotary Meeting

AT a meeting of Chicago Rotary in the Hotel Sherman, Chicago, on February 27, four hundred Rotarians were entertained by a radio demonstration of practical radio. Paul G. Niehoff was master of ceremonies. He engaged Ransome Fiske, a brilliant and youthful amateur, to set up an "operating room" on the rostrum. This was concealed by screens until after luncheon was disposed of and then the lights in the Tiger Room were switched off.

Revealed on the little platform were Mr. Niehoff and Mr. Fiske at work with a "rock crusher" from a ship's equipment. This contraption sputtered and flashed in a startling fashion. It was then announced that the speaking program would be received for that meeting by radio.

Ostensibly a program was sent over the air from WDAF, the Kansas City Star station. In reality the speeches were transmitted by radio as represented but they came no greater distance than from a room in the hotel which had been equipped for the purpose.

An address on Radio was thus transmitted by Frederick Smith, editor of Radio Age. Many of those who were present still believe that the address was radioed all the way from Kansas City.

The speaker said:

"It is indeed a pleasure to be speaking to an invisible audience which is unable to talk back. It must indeed be a pleasure to the invisible audience to be able to go to sleep and even to snore, if it so desires, without fear of offending the speaker.

"Most of the tricks of oratory are lost in speaking over the electro-magnetic waves. Gestures do not help. The flashing eye and the corrugated brow make no impression upon this cornucopia of sound known to the up-to-date as the radio microphone. Therefore the speaker by radio must depend upon facts. Being a newspaper man you will understand in what a difficult position this places the speaker.

Industrial Romance

"But while radio development in the United States will some day be recognized as one of the most interesting industrial romances of the country's history, it will not require romancing to make the voice of radio seem worth while listening to this afternoon.

"You gentlemen are having but a glimpse here of the marvelous new art upon which a giant industry is being built. What radio can do, is doing and will do for business, social progress and for civilization generally, no man may now say.

Radio Not New

"We speak of radio as a new science, or art, but we must remember that it is no such thing.

"More than a quarter of a century ago Marconi had made successful demonstration of practical wireless communication. His genius was devoted to obtaining transmission of telegraph signals through the air. He succeeded so well that for years wireless telegraphy has been used in directing ocean traffic and in intercommunication among nations and armies. Wireless is no new thing.

"Edison, Fleming and De Forest developed many phases of it when you gentlemen were still at the age when every goose was a swan and every lass a queen.

Popular Grand Opera

"It was the establishing of broadcasting stations from which music and voice could be heard at distant points with apparatus equipped with common telephone receivers that brought the world to attention.

Broadcasting of grand opera in the season of 1921-1922 literally electrified the radio world. That popular adventure in radio broadcasting sent thousands and tens of thousands of citizens in search of radio outfits. They could not understand the international wireless telegraph code any more than they could read the hieroglyphics on the tomb of jovial old King Tut in Egypt. But they could understand splendid music brought to their own firesides.

Opera listeners who hear the solos, mass singing and orchestrations get the music before it reaches the audience in the upper galleries of the auditorium in which the opera is being presented because the radio receiver gets its music by electroe-magnetic waves, which are much faster than the common sound waves.

570 Broadcasting Units

"A year ago on the first of this February there were thirty-six broadcasting stations in the United States. This afternoon there are 570 stations licensed to transmit programs of news, music and speeches and these stations represent an investment of many millions of dollars.

"Monday afternoon the Commonwealth Edison Company broadcast the news of its annual stockholders' meeting by radio.

"Banks all over the country are supplying their country clients with market and stock quotations by means of radio. The Chicago Board of Trade has purchased Station WDAP, one of the most powerful in the United States. Now news of the live stock and grain markets is officially broadcast throughout the country each day from that station.

A Moving Force

"Radio is coming to be recognized as something far beyond a fad, an experiment or a toy.

"It is a moving force in the world of today. Its possibilities are beyond our wildest dreams.

Our Boys

"There is one phase of radio history that must not be overlooked when the world begins to reap its wireless benefits in full. That phase relates to the American boy. It is the boy in knickerbockers who has brought the United States to the front as a radio country.

"It was the boy in knickerbockers who mastered the intricate science of transmitting telegraph code by wireless and who mastered the electrical equipment necessary for such transmission. These boys, who saved their dimes and built their crude laboratories in city basements or country woodsheds, are the pioneers of radio.

"They were the same boys who went to the fore when our country called for skilled men for the signal corps. They went aboard our battleships and worked the radio, thus performing a service whose importance cannot be estimated.

A Relay League

"The American boy worked days and stayed awake nights to toil with his outfit. He organized a relay league, through which messages were sent and are still sent from one end of the country to the other.

"So when the broadcasting stations appeared with their popular programs and the man or woman who understood little of electricity, found that music and speeches, sermons and news could be heard over a simple radio outfit in their living rooms, they exclaimed at the wonderful new discovery, radio. The American boy and his pioneering in code sending were practically forgotten.

Dad Listens to Learn

"It is the boy, however, who is still the radio expert.

"It is his daddy who sits humbly by and tries to learn. It is the American boy who is constantly experimenting, developing.

"If our country gains new prestige through its progress in radio, if the world becomes better, more enlightened through radio, it is the duty—and I may say it will be the privilege of every man of us—to take off our hats to the American boy and say, 'You did it, youngster.'"

Good!

Congressman White introduced in the last Congress a joint resolution in the House directing that the Federal Trade Commission investigate the status of the radio industry, with a view to ascertaining whether anti-trust statutes have been violated. The Commission was directed to investigate the ownership of radio patents used in interstate and foreign commerce and to examine contracts and agreements controlling manufacture and sale of apparatus, and also to learn whether there exists agreements giving exclusive rights or special privileges in the reception and transmission by radio.

Multi-Layer Coils

Multi-layer coils, that is coils having more than one layer of winding, are used in radio and many other classes of electrical work. The simple form of coil, that is, one wound layer on layer, has a very considerable capacity between the windings and is, therefore, unsuitable for radio work in which the capacity of the coils must be kept as low as possible. Various means have been used to reduce this capacity, such as special forms of winding and methods of separating the different windings from each other.

In the design of electrical apparatus and particularly radio apparatus, it is important to be able to calculate the inductance of the various types of multi-layer coils. Formulae for the inductance of simple types of multi-layer coils have been derived by a number of scientists, and it has been found that for the special types of low-capacity windings employed in radio work, the same formulae apply as for a simple circular coil of rectangular cross-section provided that an appropriate correction is made for the space occupied by the insulation.

These formulae, however, are complicated and for any given case the necessary computation is tedious. Furthermore, there are a number of different formulae, each one suited to some particular type of coil, so that the engineer may find it difficult to select the formula best suited to his particular problem. Methods having for their object the avoidance of these difficulties have been in use for some time, but none of them allow an accuracy greater than 1% at the best, and in some instances the use of such approximate formulae give only a very rough degree of accuracy.

Scientific Paper No. 455 of the Bureau of Standards, "Tables for the Calculation of the Inductance of Circular Coils of Rectangular Cross-Section," may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at ten cents a copy, gives tables which have been carefully calculated by means of which the inductance of multi-layer coils may be quickly and accurately computed by the simplest of mathematical operations.

The values in the tables are correct to one part in 10,000. The necessity for long and tedious computations directly from complicated formulae and for selecting the most suitable formula for a given case are thus avoided. The formulae on which the tables are based are collected for reference, and the theoretical problems involved, as well as the limitations of each formula, are discussed. Examples are given to illustrate and explain the use of the tables and the calculation of mutual inductance for certain cases of multi-layer coils is treated.

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A Radio Hero

Harry Sadenwater, one of the heroes of the air service of the United States navy, has been placed in charge of the technical operation of the broadcasting stations of the General Electric Company, including WGY at Schenectady, N. Y., and the projected station at San Francisco, Cal. The selection of Mr. Sadenwater was made by Martin P. Rice, director of broadcasting.

Two years before he entered the ranks of the Radio Engineering Department of the General Electric Company, Mr. Sadenwater was a lieutenant in the United States Navy and was one of the few out of hundreds of volunteers selected for the hazardous flight of the NC flying boats, NC-1, NC-2 and NC-4. across the Atlantic, from Newfoundland to Portugal.

Lieut. Sadenwater was radio officer on the NC-1, commanded by Lieut. Commander P. N. L. Bellinger. The NC-4, it will be recalled, was the only one of the three boats to successfully make the crossing. The NC-1, which carried Lieut. Sadenwater, encountered heavy fog. Navigation was made so difficult that the big flying boat was brought down to float on the sea until the fog lifted. Instead of the calm sea expected the boat ran into rough water and in a very short time the NC-1 was so badly rammed by the waves that it was impossible to ride off the water and every minute added to the damage.

Lieut. Sadenwater sent out S. O. S. calls until the batteries became exhausted. Nothing remained but to wait for a passing boat or the complete destruction of the hydroplane. A Greek freighter, the S. S. Ionia, finally sighted the NC-4 and picked up her crew which was landed safely at Horta Fayal, in the Azores. Lieut. Sadenwater, with other members of the crew, was made a knight of the Military Order of the Tower and Sword by the president of Portugal.

Wallace for Radio

Secretary of Agriculture Wallace, states that as a means of getting market information to the country, radio is growing popular. Although still in an experimental stage, he says radio broadcasting gives promise of great future usefulness.

The first agricultural news bulletins were broadcast from the Bureau of Standards on December 15, 1920.

Today, two years after its inception, the Department of Agriculture has practically a nation-wide broadcasting service for weather, crop and market reports by radio telegraph and telephone. Radio is held as an invaluable means of immediately getting news on agricultural affairs to the farmers and others interested in food production and marketing. From sixty-one radio transmitting stations of the Navy, Post Office, State Agricultural colleges and other agencies market information is broadcast daily. Requests for an extension of this service from other localities have had to be denied by the Department, due to lack of funds, Secretary Wallace states.

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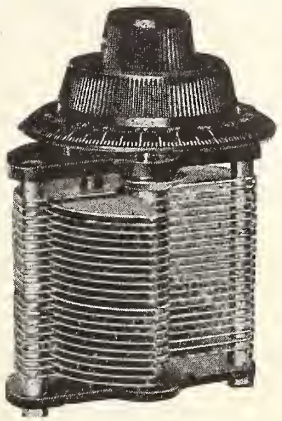
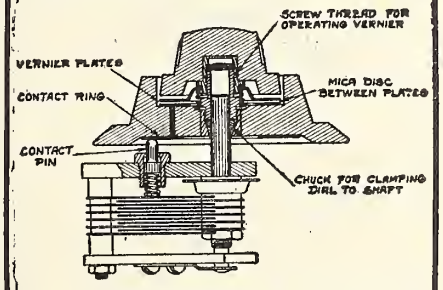
A Miracle-Worker in Fine, Selective Tuning Operates on a New Principle



Will bring in the elusive stations that have thus far defied you, by giving at least twice as fine a tuning as has ever been possible with the best condensers thus far developed.



Can be attached to any plate condenser by drilling one hole in top plate.

Price, each, postpaid $2.50.

"United" Variable Condensers With New Vernier

43 plate, each	**$6.50**
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Audio Frequency. Amplifies detected signals so they come in clear and strong, for either headphone or loud-speaker reception.

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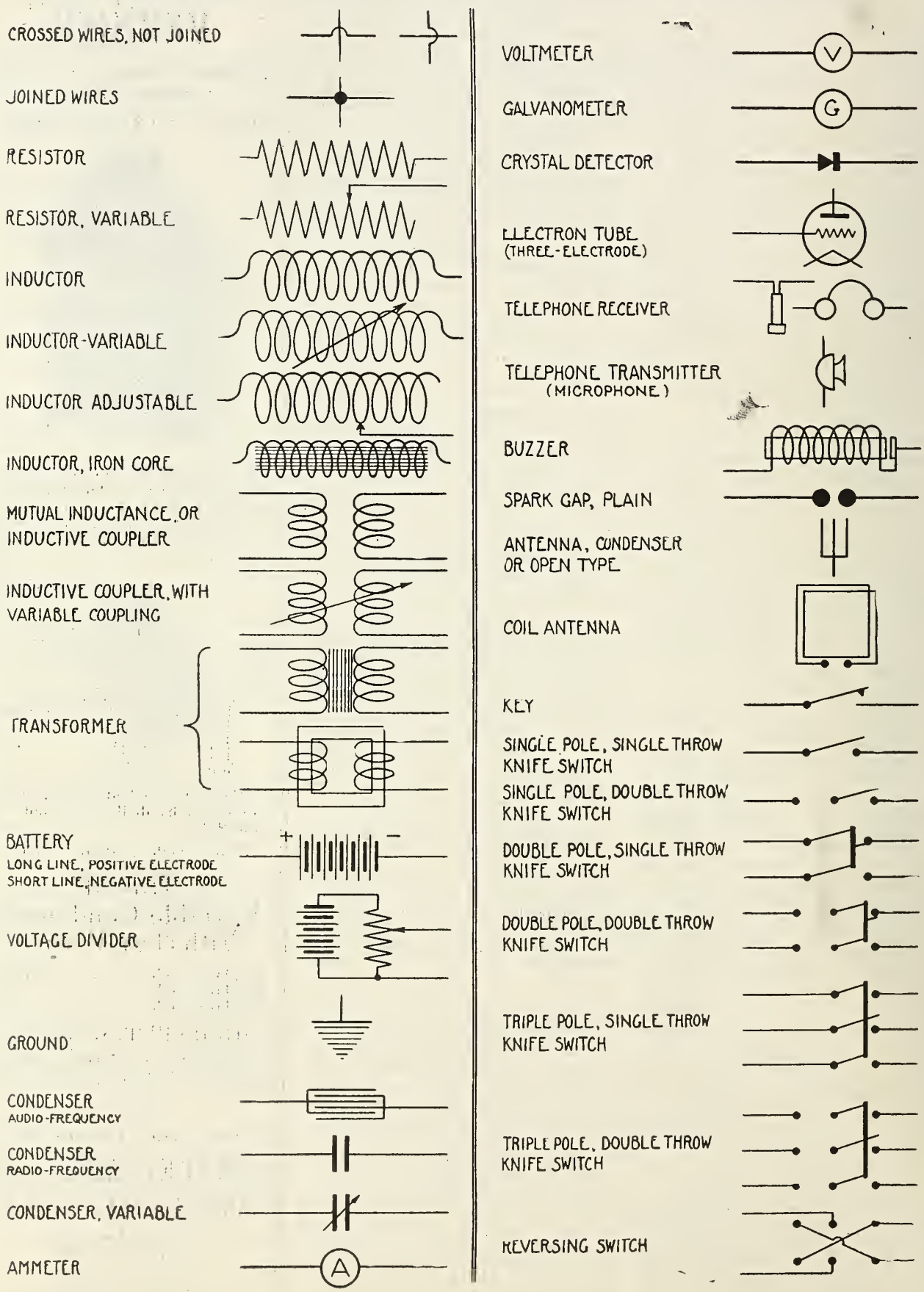
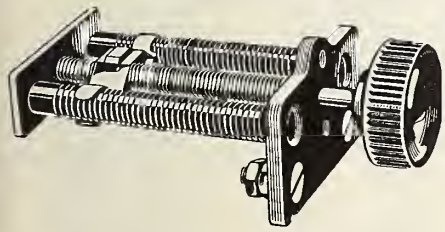


The Autostat

Representing one of the most radical advancements in Radio Filament Control, the Autostat, developed in the engineering laboratory of the Automatic Electrical Devices Company, Cincinnati, Ohio, also manufacturers of the Homcharger, has made its appearance this month and is available for general sale.

The Autostat, known as a super radio rheostat, gives the most precise control of filament current, inasmuch as it is not necessary to turn the knob a hair's breadth to get a fine adjustment, since there are forty complete turns of the knob between maximum and minimum resistance, compared to three-quarters to three turns on all others.



Its construction is radically different, too. Two parallel mounted, wire wound, fire-proof resistance tubes are connected in series by a micrometer operated slider —the length of wire in circuit depending upon the location of this slider.

It is claimed that one full turn of the Autostat knob produces finer tuning than a hair's breadth adjustment on any other—that it brings in distant stations loud and clear and tunes in those elusive stations that heretofore have remained unheard.

It gives a uniform change in resistance with each turn of the knob, possessing practically "zero" resistance at full-on position.

The Autostat is compact in size, neatly mounted, requiring less space than any other. Furthermore, it is a most economical rheostat inasmuch as only one Autostat is necessary to control two amplifying bulbs. It can also be used with six volt or W D-11 Detector tubes, or one 5 Watt Power tube.

The Autostat is popularly priced at $1.35. For further information, we would suggest that you write the Automatic Electrical Devices Company at 146 West Third Street, requesting their new bulletin No. 646.

Dry Cell Tube

The Westinghouse WD-11 vac um tube for radio receivers which operates on a single dry cell is the subject of much discussion among the radio amateurs who have been accustomed to using the big six-volt tube. This small tube, which is one of the most important developments in radio during the past year, has become very popular in the radio world, but, perhaps because of this very popularity, there has been much misinformation about its characteristics.

One of the most popular fallacies is that the WD-11 is a soft tube, only suitable for use as a detector, and that it cannot be used as an amplifier because the increased plate voltage would destroy it. In reality, however, the WD-11 is a very hard tube, mercury pumps being used during its manufacture to make sure that the last trace of air is removed from the bulb. During this operation, the filament is heated in the regular way and, in addition, a high frequency coil is lowered around the bulb which induces currents in the plate and grid of sufficient strength to bring them to a red heat. All occluded air or gas is thus eliminated.

The tubes will stand any voltage that may be put on them up to a point where the glass stem, through which come the lead-in wires, breaks down due to electrolysis. It is practically impossible to break down in vacuum. The Westinghouse Electric & Manufacturing Company, manufacturers of the tube, recommend voltages of from 22 1-2 to 45 volts when the tube is used as an amplifier.

New Vacuum Tube

A new and improved vacuum tube for radio use which uses but one-fourth the filament current of the present type radiotrons has been perfected by the General Electric Company. This can be used either as a detector or an amplifier and is interchangeable in all receiving sets now using radiotrons UV-200 or UV-201 tubes.

According to W. C. White, who developed this tube, UV-201-A guarantees quieter operation, with no tube noises, and assures greater amplification due to greater filament and plate area.

Greater electron emission amounting to about five times that of the present type tubes is given off. Much less distortion of received signals and greater volume when used in connection with loud speaker is said to be found.

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The Easy Course in Home Radio

Edited and Approved by Major General George O. Squier, Chief of the Signal Corps, U. S. A.

Seven Attractive Volumes:

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This compact little Radio Library sent prepaid for **Only $2.75**

SEND FOR IT TODAY

RADIO AGE, Inc.
64 W. Randolph Street
CHICAGO ILLINOIS

Pallophotophone

If you have tuned in to 370 meters recently and have picked up WGY you have probably been surprised at the purer and truer tone quality of music and speech from the General Electric Company broadcasting station, at Schenectady, N. Y. The answer is the Pallophotophone.

A new use has been found for the remarkable device which photographs sound on motion picture film and then reproduces the sound from the film. C. A. Hoxie, the inventor, has now devised a pick-up or microphone using the principle of the Pallophotophone reproducer.

The microphone is the link between the artist or instrument in the studio and the electrical circuit; it converts or transforms the variations of tone into corresponding variations of current. Microphones now in general use are constructed on the principle of the telephone transmitter in which the compression or expansion of granular carbon affect the electric current.

In the Pallophotophone pick-up a very sensitive diaphragm is set vibrating by sound. The movement of the diaphragm is communicated to a mirror three sixty-fourths of an inch square. A strong light strikes the dancing mirror which reflects the light beam at a sensitive light cell. The variation in the beam of light, caused by the vibration of the mirror varies the effect on the light cell and thus produces a corresponding variation in the electric circuit. Amplification is then obtained in the ordinary way by means of pliotrons.

The new pick-up eliminates the hiss which accompanies the use of the ordinary microphone; it is more sensitive and responds more readily and accurately to sound waves, capturing harmonics which would ordinarily be lost. A feature of the new pick-up is the weight of the moving or vibrating part. The diaphragm and mirror combined weigh one-tenth of a grain or half as much as the head of a common pin.

The Pallophotophone pick-up is now a permanent part of the studio equipment of WGY. Many letters complimenting WGY on the improvement of its tone quality were received after the program of January 30, when the play "Bought and Paid For," which was put out through the new pick-up, was presented.

Editorial

(*Continued from page 17.*)

be seen. Lack of a new law makes it necessary for the Department of Commerce to continue under legislation enacted ten years ago when broadcasting was unknown and there were few commercial and amateur stations.

It is probable that the Secretary will undertake the partial reallocation of wave lengths, within the limits of the existing radio law, in an effort to reduce interference and make for peace in the ether.

How Radio Grows

Number of licensed radio stations on June 30, 1913, and on January 1, 1923.

	1913	1923
Broadcasting class A		544
Broadcasting class B		25
Amateur	1,312	16,898
Special amateur	3	201
Experimental	10	291
Technical and training schools	7	126
Point to point inland	14	167
Coast stations communicating with ships	64	39
Transoceanic	1	12
Ship stations	479	2,762
Total	1,890	21,065

Number of operators licensed during fiscal years 1913 and 1922.

	1913	1922
Commercial	1,832	3,136
Experimental and instruction	8	43
Cargo	1	14
Amateur, first class	1,075	4,530
Amateur, second class	766	4,390
Total	3,682	12,113

Just what plan the Department has for improving conditions in the present radio pandemonium is not known, but a plan for execution within a few months is being worked out, it is understood.

The decision of the District Court of Appeals requiring the Secretary of Commerce to re-issue a license to the Inter-City Radio Company of New York, although that station had been severely complained of due to interference will be appealed, it was announced recently.

Secretary Hoover and his solicitor have taken the matter up with the Attorney General's office requesting that the case be appealed to the Supreme Court of the United States. It was the action of the Court of Appeals that caused Secretary Hoover to state recently that: "This removes the last shred of the Department's authority over radio."

Super Radio Survey

(*Continued from page 13.*)

resultant to modulate her short wave transmitter. This method introduces marked losses and distortion and could never be practically applied on a large scale to voice and music unless radical improvements in audio frequency circuits are made.

After all, it is not the novelty, or priority of suggestion of a new method which concerns the general public; it is the actual reduction to practice in engineering form and work is well under way to assure that the above plan for the coordination of radio effort towards the elimination of static will be in operation before the coming summer static season settles its usual blight on radio.

Station KYW

Radio fans of the United States will be entertained on the evening of April 17 with another feature attraction from Westinghouse Station KYW. Since the entire production of Shore Leave was broadcast from Powers Theatre several months ago Wilson J. Wetherbee and Walter C. Evans, director and chief engineer respectively of KYW have endeavored to develop the broadcasting of spoken drama to meet the popular demand of the invisible audience for this form of entertainment. Their efforts have culminated in arranging through the cooperation of Jessie Royce Landis, director of the North Shore Players company, a schedule of one-act plays to be produced from time to time in the studio of KYW.

The first of these is entitled Bargain Day and was arranged and directed under the personal supervision of Mrs. Landis. The part of the harassed husband will be played by Sidney M. Spiegel, Jr,. who acted the role when the play was given in Chicago. The finale lead will be interpreted by Jessie Royce Landis.

Station KYW is now widely known to be the first broadcasting station in America to have broadcast an entire drama directly from the stage of a theatre and the aim of the management is to give KYW's audience more plays and to make the station a theatre without a stage.

War Secretary on Radio

Secretary of War Weeks delivered an address before the American Agricultural Editors' Association at the Hotel Harrington, Washington, D. C., on February 26 in which he said:

"Because of the isolation of the farm, the development of communication facilities is highly important, not only in transmitting weather reports but also in broadcasting data on markets and in dispensing music and recreational programs to the living room of the farmer. The prominent part played by the Signal Corps of the Army in building up our system of wired communication is being carried on fully as effectively in the promotion of radio. The Signal Corps is responsible for the use of the vacuum tube in this country, and also largely for the development of the small radio set now used so generally by the amateur.

"General Squier's recent invention will serve to bring the radio even more generally into the home of the farmer, with the resulting enrichment of agricultural life. In certain sections, such as the early frontiers and present day Alaska, the farmer has had no communication with the outside world other than that afforded by the Army signal system. The radio web of the Army is today a reserve system that would enable our country to continue its general contacts even in the face of a complete breakdown of the civil lines. The modern farmer will appreciate what this means.

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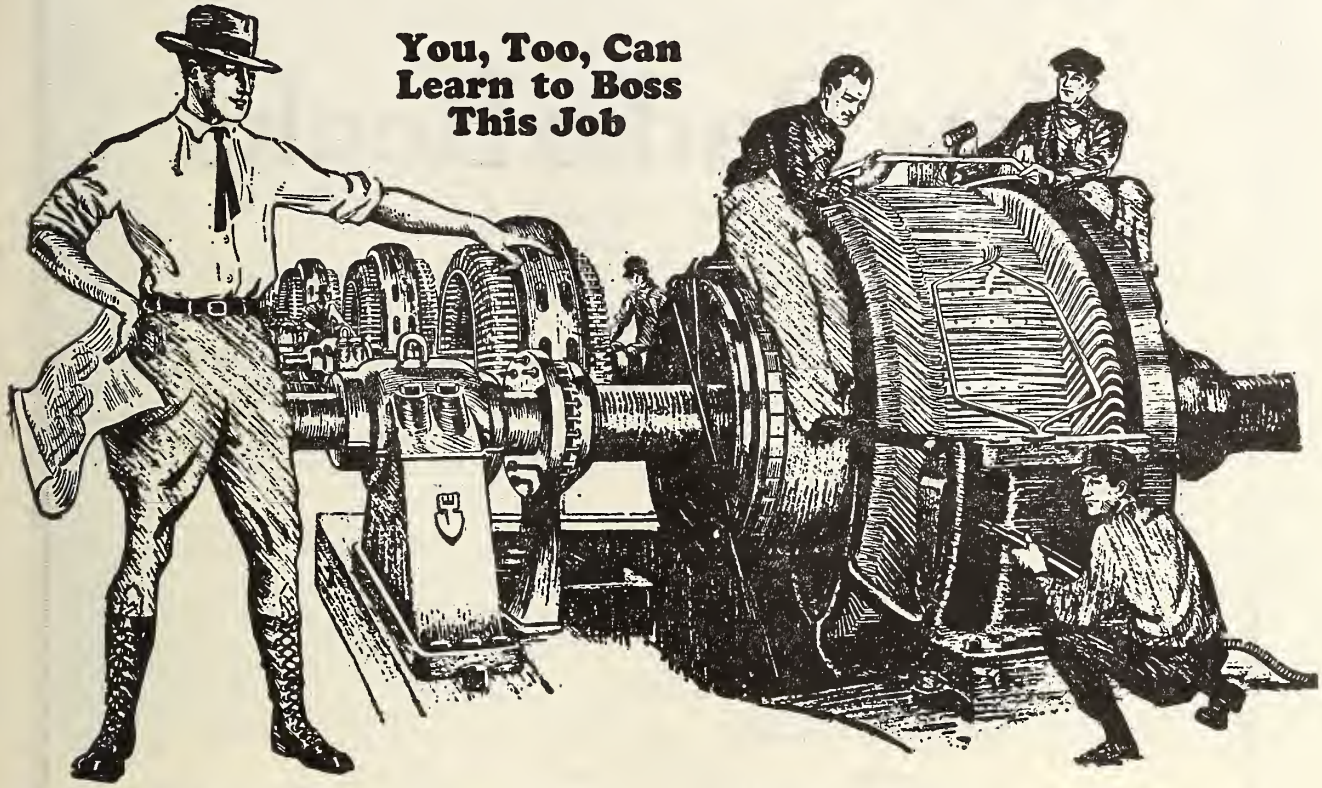

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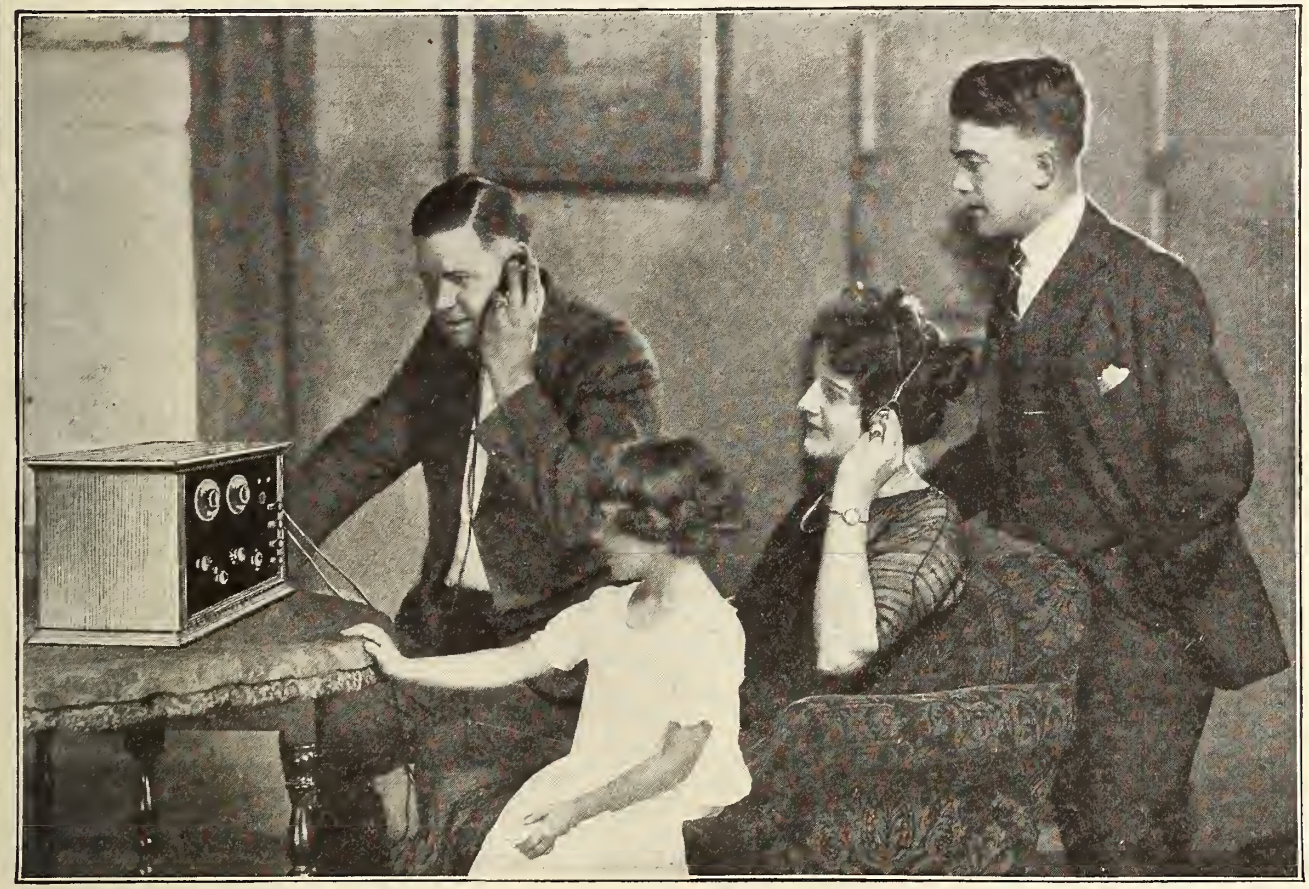

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$15

DOWN AND $10.00 PER MONTH

Immediate Shipment

Manufactured under Armstrong License, U. S. patent No. 1,113,149 and pending letters of patent No. 807,388.

READ THESE TESTIMONIALS!

Seaton, Ills., December 22, 1922.

Harold R. Waken Co.
Chicago, Ills.

Dear Sirs:

Following is a report of the different stations I received on the Sensitone Detector, and all came in very clear, on the 21st.

Ft. Worth, Texas
Davenport, Iowa.
Cincinnati, Ohio.
Indianapolis, Ind.
Pittsburg, Pa.
Kansas City, Mo.
Memphis, Tennessee.
Dallas, Texas.
St. Louis, Mo.
Louisville, Ky.
Schenectady, N. Y.
Denver, Colo.
Chicago, Ills.
Atlanta, Ga.
Newark, N. Y.
Detroit, Mich.
Minneapolis, Minn.

I did not go to bed until 3 a. m. next morning. Certainly is a fine machine. Hope to add Amplifiers and Loud Speaker in near future. I am getting stations that other radio bugs here in town don't get. 12 radio sets in town at present. 400 population, and lots of bugs here. You can use my name if you choose.

Yours truly,

D. E. HAIST,
Telegrapher, M. & S. T. L. R. R. Seaton, Ills.

Harold R. Wakem and Co.,
Chicago.

Dear Sirs:

Last night was the first night that I tried my Sensitone, and here are some of the stations that I heard very well: Houston, Texas; Denton, Texas; Fort Worth, Texas; St. Louis; Dallas News; Cincinnati; Atlanta Journal; Detroit News.

I heard ever so many others, that I just tuned in or out as they interested me or not. Now, don't you think that's a good start for a green beginner? According to what I have read I am living in the "home" of static, and I am sure there was lots of it yesterday, as it was very warm, and we had a lighting storm also.

I listened in to the St. Louis Post-Dispatch for over an hour, as their concert was fine, and everything was clear. Yesterday afternoon at three I heard Houston, Tex., very well.

Detroit is a mighty long distance rom here, so I consider your set a marvel.

With all good wishes for the coming season I beg to remain Yours sincerely.

REV. JOS. J. BOUDREAUX.

December 13, 1922, 9:49 p. m.
DB 841, 49 Collect NL., Lubbock Tex 13
Harold R. Wakem & Co., Chicago, Ill.

In answering queries relative distance performance be explicit without fear quote this telegram first night's program included Detroit News, Drake Hotel, Chicago, Kansas City, Davenport, Atlanta, Paducah, Ky., Los Angeles, San Antonio, Houston, Ft. Worth, Oklahoma City, entire cotton, cattle, hog, sheep markets from Kansas City. Two p. m.: Is more than satisfactory with thirty foot aerial. W. H. WARD. Theriot, Louisiana, December 16, 1922.

ONLY 500 SETS SOLD ON THE EASY-PAY PLAN

We are making this rather costly investment in order to get 500 sets in the hands of that number of influential families, so that, when we put our goods in the hands of dealers, they may have enthusiastic SENSITONE boosters nearby to whom they can refer their future prospective buyers.

Fill out the coupon, attach check or money order for $15.00. Set will be shipped at once by express. Those who delay will be too late.

Harold R. Wakem & Co.
900 Washington Blvd. CHICAGO

HAROLD R. WAKEM & CO.,
900 W. Washington Blvd., Chicago, Ill.

Enclosed you will find $15.00 as first payment, upon receipt of which you will send me your complete Sensitone Radio Receiving Set, as described above. After I have used the set for thirty days, I agree to send you $10.00 and the same amount every thirty days thereafter, until the full purchase price of $95 is paid. This set is to remain the property of Harold R. Wakem & Co. until payments are completed.

Signed.....

Street address.....

City.....

In the spaces below give the names of two references, (banks or business houses preferred).

Name and Address.....

Name and Address.....

Reinartz Radio

How to make this distance wrecker.
How to amplify it.
How to make a Reinartz panel.

With Hook-ups

Written and Illustrated by
FRANK D. PEARNE
Chief Instructor in electricity at Lane Technical High School, Chicago, and famous writer on radio construction and operation.

Experts agree this Reinartz Hook-up is best for average fan.

Hook-up for the Long Distance Crystal Set—They are all trying it.

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RADIO AGE

The Magazine of the Hour

Price 25 cents

MAY, 1923

IN THIS NUMBER

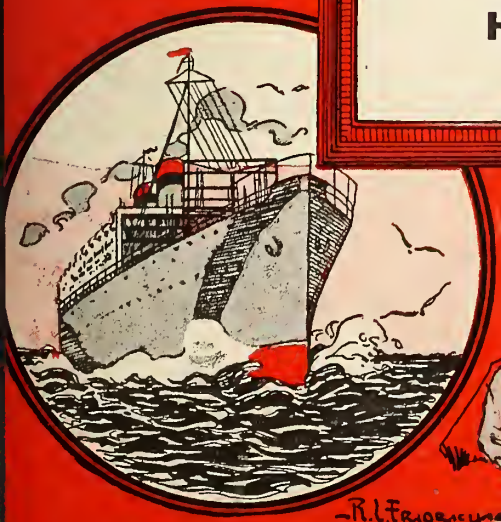
How to Make the Erla Single Tube Reflex Receiver

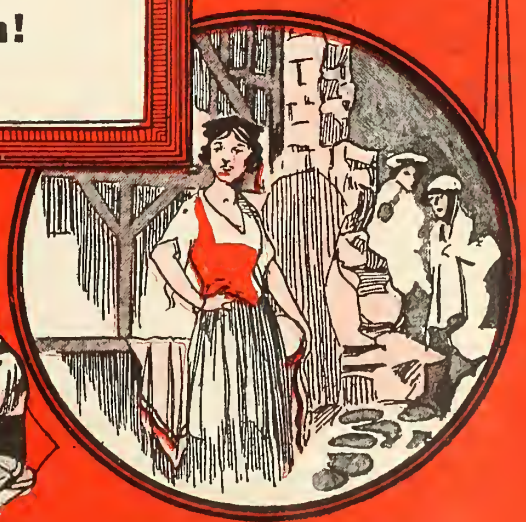
How to Make a Portable Reinartz Set for Summer Use

Radio Music Cannot Be Throttled

Complete Corrected List of Broadcasting Stations

Hook-ups --- Lots of 'em!





OFFICIAL NEWS MEDIUM FOR NATIONAL BROADCASTERS' LEAGUE

Blairco Radio

Buy at the Radio Store where they display this sign—the distinguishing mark of Blairco Proven Products.

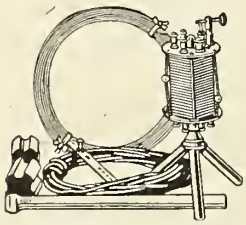
Atlas Head Phones

The only high grade receiver set offered at a reasonable price. Sensitiveness and adaptability positively is unequalled—price $9.00.

Atlas Loud Speaker

Height over all 21 in. Horn 11-in. in diameter, of seamless vegetable fibre, dense and non-vibrating. Sound reflecting base and unit casing of dark red polished Bakelite. Priced complete with horn attachment and cord—$25.00.

The Atlas Gives Tone Volume With Perfect Tone Control



Blairco "4" Crystal Set

Take 4 head phones—Enables 4 to listen as well as 1. All nickeled steel 9" high. Price only $7.50. Complete with copper clad aerial, waterproof lead-in and ground wire, strain and wall tube insulators, lightning arrester, ground wire clamp and set of $9.00 Blairco Headphones—$17.50.

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Multiplied enjoyment with your radio follows the use of a loud speaker which, set in any convenient spot, throws out the tones so that a roomful of family and friends can hear.

But in selecting the loud speaker, bear in mind that loudness without clearness is mere noise—and get an ATLAS.

With the Atlas you get the true tone of the original—clear, pure, exquisitely sweet—and perfectly controlled. Tone distortion, distracting mechanical sounds, confusing echoes and blasts—all are noticeably absent.

All is due to the patented double composition diaphragm—found only in the Atlas. And to the use of finer materials which, with scientific assembling, also insures permanence.

A typical example of the extra quality offered at no extra cost by all radio equipment sold under the Blairco trade mark.

No matter what you want in Radio, buy at the "Blairco" Radio store and get dependable value. Every article sold under the Blairco trade name, whether our own make or others, is of proved superiority. Exacting tests have proved it the best of its kind, bar none!

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"First With the Best"

1429 South Michigan Ave., Chicago

RADIO AGE

The Magazine of the Hour

Volume 2 *MAY, 1923* *Number 4*

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Our Anniversary

WITH this issue of Radio Age we embark upon the second year of a pleasant voyage on the waves of wireless. We celebrate our birthday anniversary by moving into new and larger offices at 500 North Dearborn Street, Chicago. We celebrate also by adding another competent radio expert to our technical staff. We celebrate by the addition of a circulation expert who is directing our rapidly increasing sales on news stands in every state in the union. He has just returned from a tour of the New England states where the results have been particularly gratifying.

Dealers report to us that there are numerous radio fans who insist on having their Radio Age each month regardless of how many other radio publications may be offered. There's a reason. Our readers have discovered that there are original articles and drawings in each issue of the magazine that appeal to the man who wants to make something. We may be giving away a trade secret to the opposition when we make the foregoing statement. But we take that chance, confident that the following we have established will continue its loyal support and celebrate many other birthdays with us.

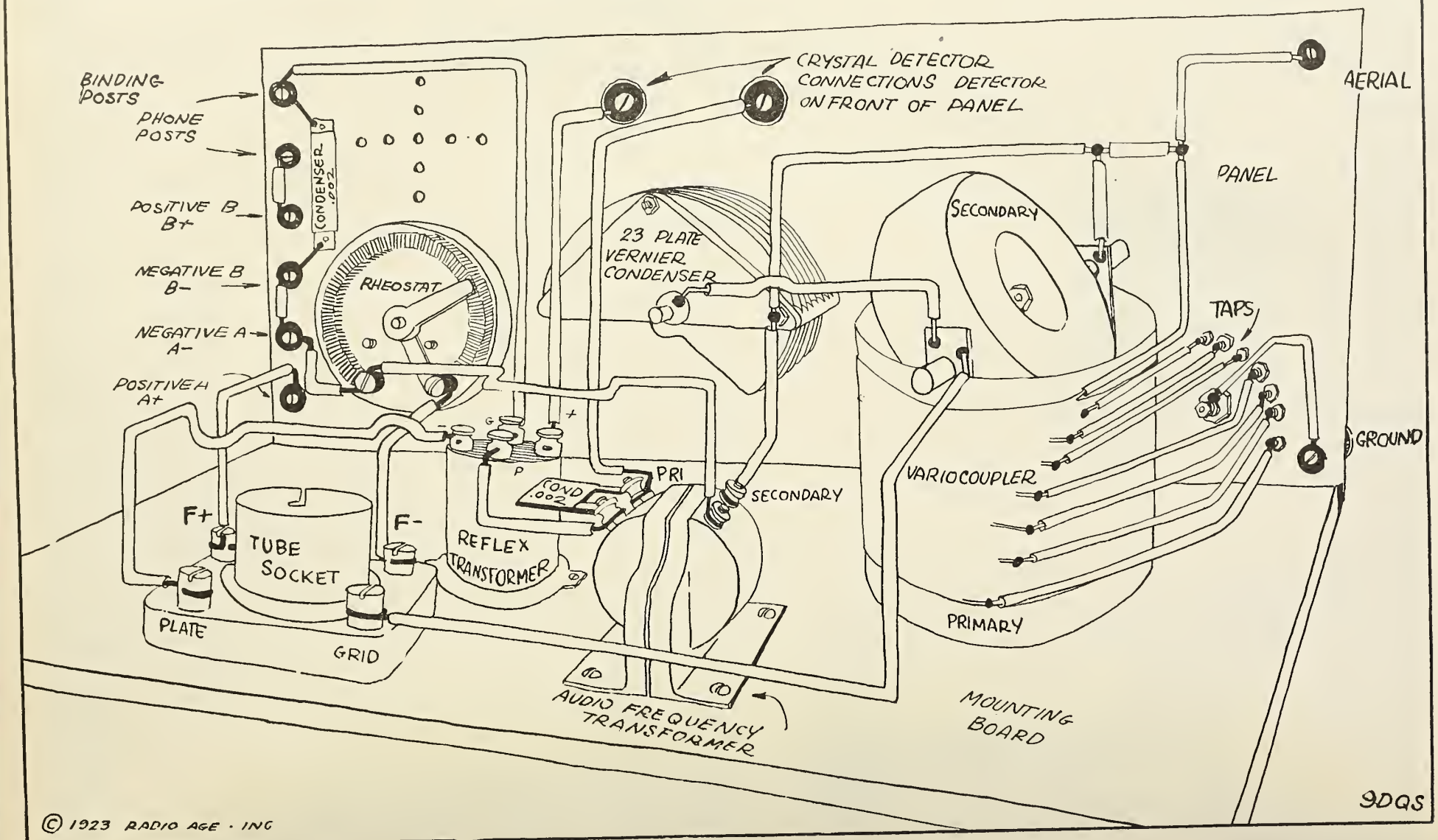
Since the first issue of Radio Age operators of receiving sets have increased from thousands to millions. Broadcasting stations have increased from thirty-six to five hundred and eighty-nine. This magazine has become the official news medium of the National Broadcasters' League which is the biggest association of its kind in the world. This magazine was the first radio publication west of the Atlantic to publish a complete, corrected list of broadcasting stations, with program and time schedules in each issue.

In all humility we confess to having found many steadfast friends, far and near. Herewith our thanks.

—The Editor.

ERLA REFLEX CIRCUIT

WITH PANEL ARRANGEMENT AND WIRING ILLUSTRATION



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RADIO AGE
"The Magazine of the Hour"
M. B. SMITH
PUBLISHER
PUBLISHED MONTHLY
FREDERICK SMITH
EDITOR

How to Construct the New Erla Single Tube Reflex Circuit

Brings in Distant Stations on the Loud Speaker

By F. D. PEARNE

TO HEAR it said that with a single tube circuit, stations from all over the United States could be picked up loud and clear on a loud speaker would make the radio fan shake his head in doubt. Never the less this is now an accomplished fact and a tremendous advance in radio progress has been made. The new Erla single tube reflex circuit is doing this very thing and the results obtained by this arrangement will surprise the most skeptical.

It is hard for the average amateur to keep up with the rapid improvements in the radio field, with the new circuits coming so fast that before he has advanced far enough in the construction of one set, another is upon him and he wonders where it will all end. This may be discouraging to the amateur, but it just goes to show that radio has aroused the interest of the entire world and is a good omen. With this enormous body of thinking people behind the thing, we may feel quite sure that the future will soon show results in the art of radio reception heretofore undreamed of.

Now comes the Electrical Research Laboratories with a new reflex circuit, using a single amplyfying tube, which will duplicate in power and range, the multistage amplifiers now in use, cutting down the expense of operation to less than one third of the ordinary three tube set. This means a great deal. For one thing, the storage battery is only called upon for one third of the discharge occasioned by the three tube set, which makes it possible to use the storage battery three times as long without charging. Then there is the wear and tear on tubes, reduced to the limit and the ease of adjustment with which the set may be operated.

By using the new 201-A or the 301-A tubes, the storage battery may be eliminated and three cells of dry battery substituted, making the receiver easy to move from one place to another, in other words, a portable set which can be conveniently taken along on the summer vacation, with little or no trouble.

For the reception of local broadcasting and distances up to 250 miles a loop aerial can be used with excellent results, which is another very important feature to the fan who is not allowed to place an aerial on his building. Very good results can be obtained by merely attaching about twenty feet of stranded copper wire in place of the aerial and throwing it on the floor, but where an outside aerial is used a maximum length of seventy-five feet is recommended. If a longer aerial is used, it will only serve to broaden the tuning, with no apparent increase in efficiency.

Material for Construction.

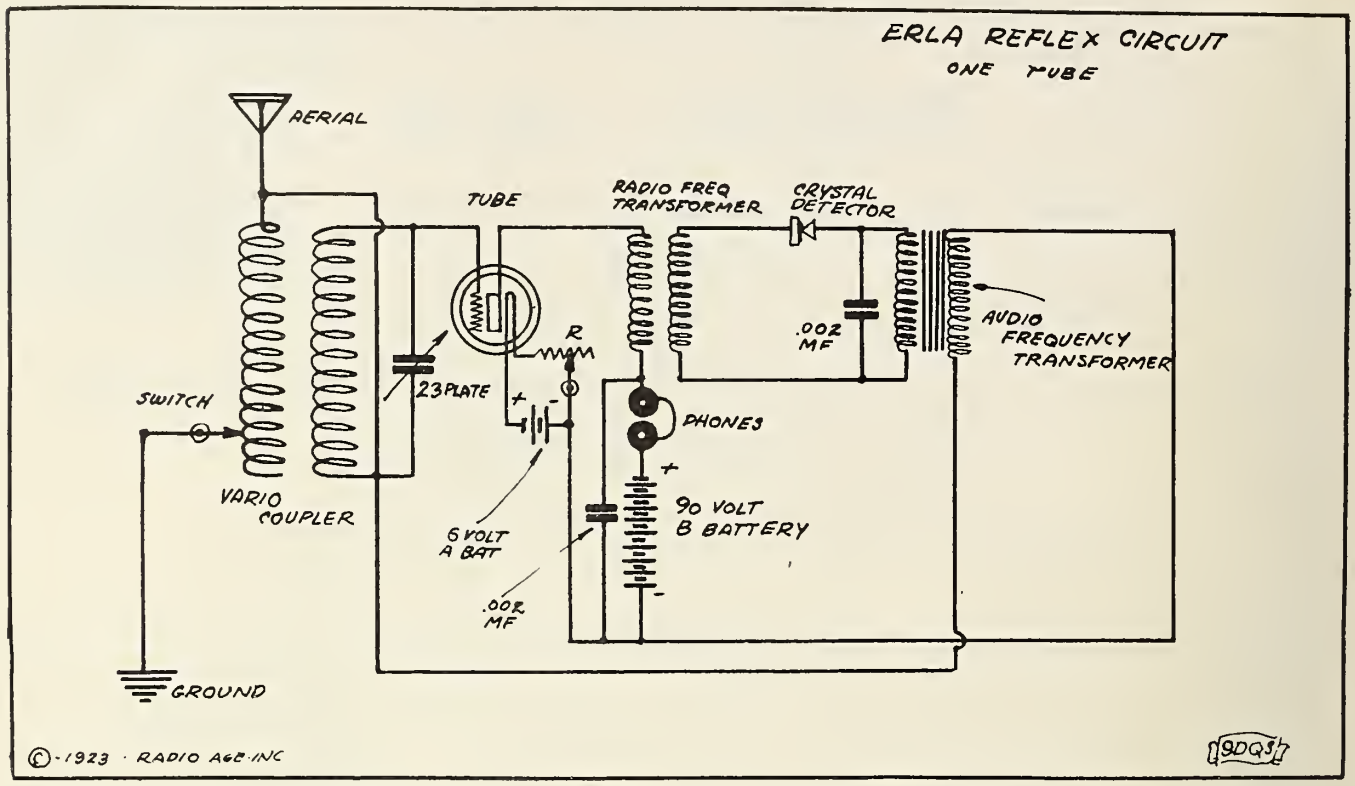
The parts necessary for the construction of the set are few in number, and the cost is low compared to the amazing results obtained. They consist of the following: One cabinet with a Bakelite panel 6x15 inches and 3-16 of an inch in thickness, one Erla reflex radio frequency transformer, one audio frequency transformer, having a ratio of 5 to 1, one ordinary vario-coupler, two sets of contact points with stops, two switch knives, one variable Vernier condenser having twenty-three plates, one Radiotron 201-A or 301-A tube, one rheostat (25-ohm), one crystal detector, one vacuum tube socket, two dials, one fixed condenser, .001 M. F., one fixed condenser .002 M. F., one "A" battery (six-volt storage, or three dry cells), four to six "B" batteries of 22 1-2 volts, eight binding posts, one pair of head phones, and one loud speaker.

How It Is Constructed.

The panel is secured to a one-half inch thick base board which is just wide enough to reach the back of the cabinet when the panel is in position. The holes for the switch contacts and stops are drilled in a convenient place in front of the vario-coupler and the taps from the primary winding of the coupler are soldered to them, as shown in the drawing. The shaft of the coupler extends through the panel and one of the dials is fastened to it. The crystal detector may be mounted at any convenient place, preferably at the top and on the outside of panel. Mount the variable condenser in the position shown, with the shaft extending through the panel upon which the other dial is mounted.

The rheostat should be mounted directly in front of the socket and holes are drilled with a one-fourth-inch drill just above the rheostat so that the filament of the tube may be observed through the panel. The arrangement of these holes is shown. The two transformers are mounted on the base board in such a way that all connections will be as short as possible. These short connections are very necessary where ever radio frequency is employed.

The location and connections of all the binding posts are clearly shown and one should have no trouble in following out the general idea of the circuit. Many of those who have had experience with crystal detectors will be in doubt as to how this piece of apparatus can be very sensitive in a circuit



of this kind, but it must be remembered that the difficulty experienced in adjusting the crystal in the ordinary crystal detector set will not be found here, as the incoming signals will have been greatly amplified before they reach it, and it will be found to work on any point and work well if a good crystal is used. All wires should be covered with sleeving to keep them well insulated and prevent them from coming in contact with each other, and all connections must be carefully soldered.

Action of the Circuit.

In reflex circuits the tube is used for two purposes. Radio and audio amplification are both obtained through the same tube, therefore the tube does double duty. The first impulse which reaches the instrument from the aerial is amplified at radio frequency, through the special transformer and vacuum tube employed. It then goes to the crystal where it is rectified and detected, after which it is passed through the audio frequency transformer and back through the tube again. This gives double amplification and in addition, there is an extra reflexing of amplified impulses which are returned to the tube through the transformer windings, condensers, and filament circuits of the set.

So, in the single tube Erla circuit, in which the crystal serves as the detector, the conventional three tube circuit, with one stage of radio and one stage of audio amplification is obtained. Comparative tests have demonstrated that the absence of detector amplification, such as is usually gained by using a tube detector, is more than compensated for, by the increased resonance of the circuit and the double reflex secured.

The reflex action should not be confused with the Armstrong regenerative principle, as no relation between them exists. In reflex action the plate current undergoes a transformation in wave form, phase, and frequency, the complex result being re-impressed upon both grid and plate circuits in a form that enables the tube to give separate and distinct radio and audio amplification. Whistles, howling, and distortion such as are encountered in feed-back circuits are not apparent in the reflex circuit. To obtain the best results with the 201-A or 301-A tube, it should be operated as near the spilling point as possible in order to carry the reflex audio frequency impulses to the highest attainable amplification. To make a test for maximum amplification, lift the contact point off from the crystal, which will, if the adjustment is good, throw the tube into violent oscillation, which will return to normal condition when the contact is replaced.

NEW STUFF

A radio tube, which consumes 70 per cent less current than any of the small or so-called peanut variety now being sold and the first to operate with the filament current supplied from the ordinary flashlight battery, has been perfected by the General Electric Company. It will be known as the UV199. It will be described in the June number.

The Music Row.

BROADCASTERS from all parts of the country met in Chicago on April 25 to discuss ways and means of getting music for broadcasting purposes. The owners of stations apparently will pay no tax to the American Society of Authors, Composers and Publishers for the privilege of broadcasting copyrighted music.

Scores of letters from members of the National Broadcasters' League indicate that the station owners prefer to dispense with music rather than submit to what they regard as extortion.

At the Chicago meetings it was evident that broadcasters have in mind a plan to obtain music from independent publishers, authors and composers, who will arrange with representatives of the broadcasters to furnish popular music for radio purposes, getting their recompense from the sale of music stimulated by this wide advertisement of their wares.

One of the meetings in Chicago was held under the auspices of the Chicago broadcasting stations and the other was called by the National Broadcasters' League, the nation-wide official organization.

Detailed reports of both conferences will appear in the June number of Radio Age.

How to Make a Portable Reinartz Outfit for Summer Use

By FELIX ANDERSON, Radio 9DQS

WITH the approach of summer, people in general abandon the indoor pleasures and diversions which go with inclement winter weather and usually venture forth in search of entertainment outdoors. Many people have already realized the entertaining value of a radio set, and have installed large multicontrol sets, necessitating storage batteries, cabinets and the other familiar accessories. Of course such a set usually remains stationary in one section of the house, and with the advent of summer will fall into disuse due to its cumbersome nature, making easy transportation impossible.

Something of a more diminutive size and which utilizes less apparatus and accessories is in demand; a set which can be readily installed, dismantled, packed into a small space, and then again be installed with a minimum amount of trouble and labor.

With summer comes the vacation season, extended motor tours, excursions, and camping trips. There are motorboat rides and week end trips to summer homes, and countless other forms of entertainment. There are doubtless people who would like to take a radio set along, but the prevalent idea of too much trouble makes them hesitate.

You will no doubt recall times when you were in camp, and were lazying before a fire wishing you could find something to do which did not take much effort; or you were out in a motor boat and were pondering as to what kind of weather tomorrow will bring and what's going on in the city, though perhaps you are miles and miles away from the city, a mere turn of a knob or two on a portable radio set will give you all the necessary information you wish.

One will agree that of course it is a perfectly good thing to talk about, but is it feasible? Who wants to drag a lot of clumsy cabinets, batteries and other accessories, which are usually necessary with the present radio sets, along on a vacation or camping trip?

With the predominating ideas of compact arrangement and minimum size, together with the ease of transportation let us build a portable set which you can take along on any of the summer trips, and with which you can, by carefully executing the instructions which follow, receive over a radius of 300 miles or more at nightime. With the powerful broadcasting stations of today, no matter where you camp in the United States you will be within the range of some station and you will find it a great sport to have as your central station some station other than the one you have been accustomed to listen to. To go on with the set:

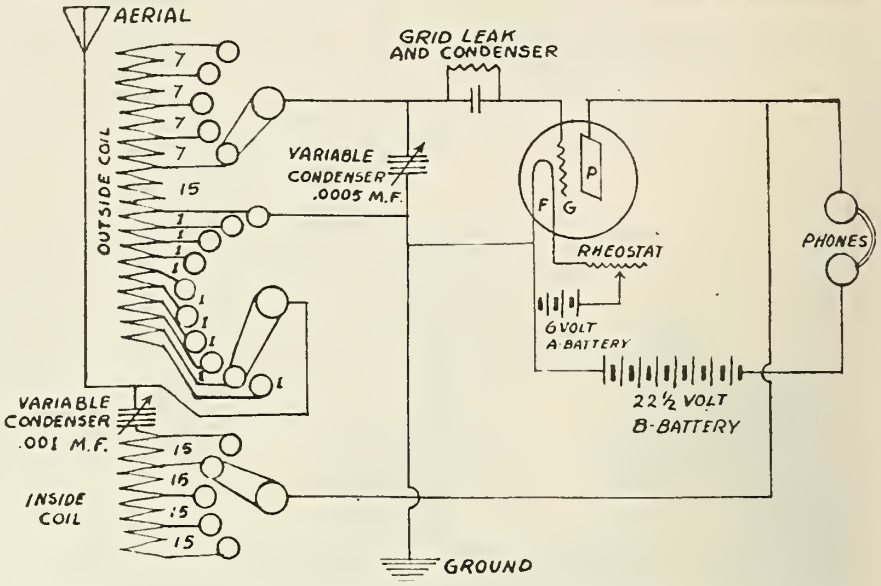
Construction.

Because of the ease of constructing and the minimum expense involved, together with the efficiency of the circuit, the REINARTZ hookup will be used. The parts for this circuit can be purchased without trouble, and due to the small space the builder has at disposal this circuit seems best.

It is a well known fact that it approaches nearly anything now in use and a discourse on the advantages of this REINARTZ CIR-

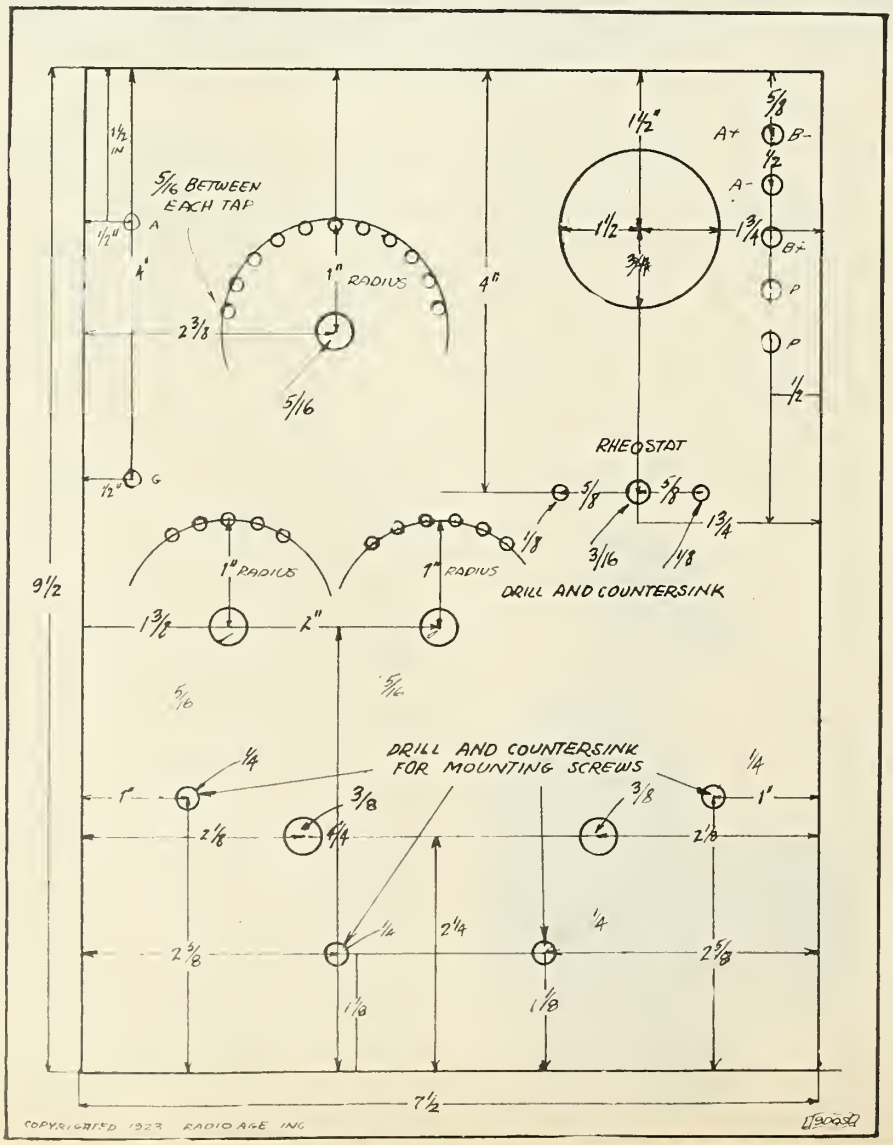
CUIT is hardly necessary. The required parts for this portable REINARTZ set are as follows:

1 School Satchel, 13x9½x6 inches
1 Panel, 7x9½x1-4 inches
1 23 Plate Condenser Vernier
1 11 Plate Condenser Vernier
1 Pfanstiehl Reinartz Coil
3 Switch Levers
2 Dozen Switch Points
1 Tube Socket
1 Rheostat Vernier
7 Binding Posts
1 Pair Phones
1 22½ Volt B Battery
1 Grid Leak and condenser
200 Ft. No. 18 Copper wire, uninsulated
2 Cleat insulators
Tube and filament battery



An ordinary school case will serve the purpose admirably as a medium for placing the apparatus in. Something of sturdy, well built make is recommended, as the set will have to be constructed to withstand bad weather, and rough usage. It can be purchased in practically any department or school store at a cost of less than two dollars.

The panel is of bakelite or of other dielectric, 9½ inches high, 7½ inches wide and 1-4 inch thick. As all the apparatus is to be mounted on this small panel, care should be taken in the drilling, as space is the most valuable item on the set.



Two variable condensers are screwed on the panel, toward the grip side of the suitcase, the 23-plate vernier being mounted in the lower left hand corner and the 11-plate in the lower right hand corner.

Vernier condensers of the United type were used in the set made up by the writer, effecting very close tuning, and also because of their sturdy construction and small size. Because of the vernier, the panel will not be flush with the top of the satchel. The panel is lowered so that the cover of the grip can be closed without touching the knobs. This also makes it possible to lay the 200 feet of antenna wire which is wound in 2 coils of 100 feet each on top of the panel when the set is being carried. The No. 18 wire is used as it has less weight and can be more readily wound into coils about six inches in diameter.

Three small switches, having a radius of 1 inch each are used, and are mounted on the upper and center left hand side of the panel as the panel layout shows. The top switch is the primary control having 11 taps; the lower right hand switch, has 5 taps and controls the grid circuit, while the remaining switch is the plate feedback control, and has 6 taps. The panel layout shows the arrangement and the sizes of the holes to be drilled.

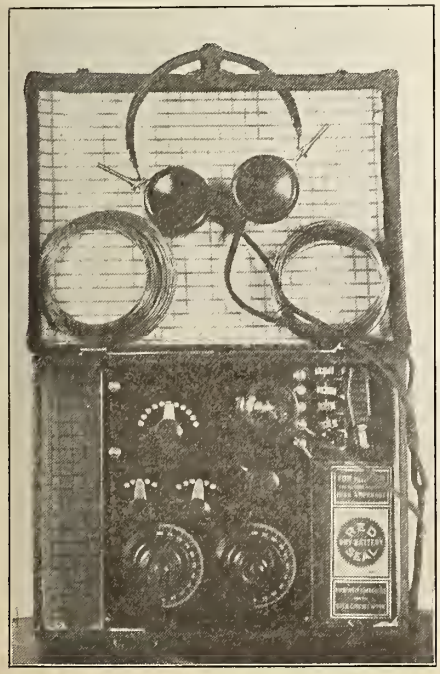
Directly behind the switches and taps, the Reinartz inductance is placed. A Pfanstiehl coil should be used here, chiefly because it can be mounted without any other support than the tap wires which if firmly and carefully soldered will hold the inductance in place without any other support. The inductance should be placed as close to the panel as possible, without crossing any of the taps.

A 1½ inch hole is cut out of the

panel with a copeing saw in the top left hand corner 1½ inch from the center of the hole to the top of the panel and 1 3-4 inch from the right side of the panel to the center of the hole. The tube socket is inserted here, the conservation of space making it necessary to have the tube on the outside of the panel when in use. A vernier rheostat is mounted directly under the tube socket 4 inches down from the top of the panel. The mounting screws on both the condensers and the rheostat should be countersunk in order that the knobs may pass over them without scratching.

Five binding posts are mounted parallel to the socket and rheostat, the top being the positive A battery (A+), the second from the top, the negative A (A−), the third the positive of the B Battery (B+) while the remaining two are the binding posts for the headset. The negative of the B Battery (B−) is connected to the positive A (A+) binding post, making the use of an extra binding post superfluous.

If the builder intends to use an automobile on his trips, a regular six-volt tube is used, in conjunction with the battery of the machine. The connection may be taken from the dashboard of the automobile by removing the dashboard light and inserting a plug in the socket. The connection should then be run from the plug to the set, the polarity of the wires from the plug being determined from the wiring of the car. To make the set an entirely independent portable outfit, a bulb, using a low filament voltage, such as the W-D-11, must be used. If this arrangement is used, the dry cell is placed in the compartment just to the right of the panel as is the small block 22 ½ volt B Battery.



The best antenna to be had is a single wire 75 to 100 feet long, strung between two trees, houses, or poles. If a tree is used care should be exercised that no leaves or branches touch the wire as this will make the signals fade.

If the set is to be used on a motor boat a loop antenna may be used, consisting of 4 turns of No. 18 wire on a frame 3 feet square. The ends of the loop are connected to the ground and antenna binding posts of the set. If the boat is a large one an ordinary antenna is used on the boat, the customary connections are used, a ground being obtained by dropping about 20 feet of wire over the side of the boat.

A ground may be obtained, if the set is used on land, by running a wire to a pond, brook or stream, or as a recourse, bury from 25 to 30 feet of the wire under moist ground about six inches deep. If a pipe is handy drive it into the ground about 4 feet and after scraping it bright wrap a piece of tinfoil around the pipe and then twist the ground wire around the tinfoil. This will insure a good contact. If possible, the pipe should be filled with water.

The set is so constructed that after it has been used as a portable set it may be taken out of the satchel and mounted in a handsome polished wooden cabinet, and can be used as a regular receiver in a home. The set can be constructed for less then $30, using a dry cell tube, the cost including the antenna, phones, and tube. The possibility of using it for more than a portable set makes it worth the expenditure many times. With care exercised in construction astounding results may be obtained, and the reader will no doubt find the set a worth while proposition as an ideal summer receiver, should he decide to construct one.

The writer will be glad to answer questions on construction and operation if addressed to the Technical Department of this magazine.

The Mississippi River is now the dividing line between the "K" calls of the West and the "W" calls of the East, as far as broadcasting stations are concerned. All new calls issued to broadcasting stations east of the Mississippi will begin with "W" and those west with "K," so the stations can be immediately identified as Atlantic or Pacific when the initial letter is heard. The stations already listed under "K" will retain their original calls.

Showing the vacation radio fan starting off with his outfit of receiving set with batteries, aerial, and even cabinet complete, all contained in one small traveling case.

In order to get an idea of the immensity of the weather broadcasting carried on daily, an estimate of the number of words transmitted daily by the Governmental stations was fixed at 8,000. A reduction is made on Sundays, when approximately 6,000 words are handled. At one Naval station, Altena, Illinois, approximately 150,000 words are handled during the lake shipping season, between April 15 and December 15; this is one of the largest traffic schedules of the whole system of 98 stations.

WOC, Davenport and KSD, St. Louis, have published attractive booklets describing their stations and presenting excellent half-tone pictures of studios, operating rooms and entertainers, etc.

"Have they arranged to send money by radio yet?" asked a fan.

"Probably not;" replied his wife, "too many people would 'pick it up.' "

Send $1.00 to Radio Age, 500 N. Dearborn St., Chicago, and receive this middle-west radio periodical for six months. Regular subscription price is $2.50 a year.

End of Interference Promised

By CARL H. BUTMAN

WASHINGTON, D. C.—Interference, the bugaboo of both radio operators and fans, will be greatly reduced, if not eliminated, by May 15. On that date, the assignment of about thirty-five exclusive wave lengths to some thirty localities, where Class B high-powered broadcasting stations are situated, will go into effect. Wave lengths for Class A stations will also be assigned by districts by May 15, it is hoped.

Although Secretary Hoover is understood to have approved of the tentative allocation of the specific wave lengths to broadcasting stations, it is pointed out that each district radio inspector must now confer with the local operators and owners before the wave lengths are definitely assigned. For this reason the list is not yet made public.

The tentative distribution of broadcasting waves is based on the recommendations of the Second National Radio Conference and is the first step in the application of the wave band allocations made recently.* It will mean that anyone in the United States with a good receiving set will soon be able to pick up each and every high-powered radio broadcasting station and most of his local stations without experiencing the interference which has been prevalent for many months.

Practically every B station will have a National exclusive wave length, between 300 and 345 or 375 and 545, except where there are two or more in a locality, but the waves are assigned to localities rather than stations and will have to be shared in some cities. In four instances, in New York, Philadelphia, Los Angeles and San Francisco, two or three additional wave lengths will also be assigned but they will not be exclusive nationally. Those waves allocated on the Atlantic Coast will be repeated in the Pacific Coast cities. While not exclusive, these additional waves will aid in supplying additional facilities and will scarcely cause interference as the stations will be about 3,000 miles apart. The difference in time of three hours will also tend to eliminate any interferences. As soon as the nine radio inspectors can arrange with the Class B station owners in their districts, authority to broadcast will be issued on the specified wave lengths and stations will be required to use them only.

Where two or more stations exist, a time schedule will be arranged until the assignments are made definitely, B stations will continue to operate on 400 meters, and C stations on 360, but by the middle of May it is hoped that all readjustments will be completed and the transfers made. A few radio wave lengths in each district have been reserved because of anticipated interferences with other lines of communication or held for new stations.

Class A Wave Lengths.

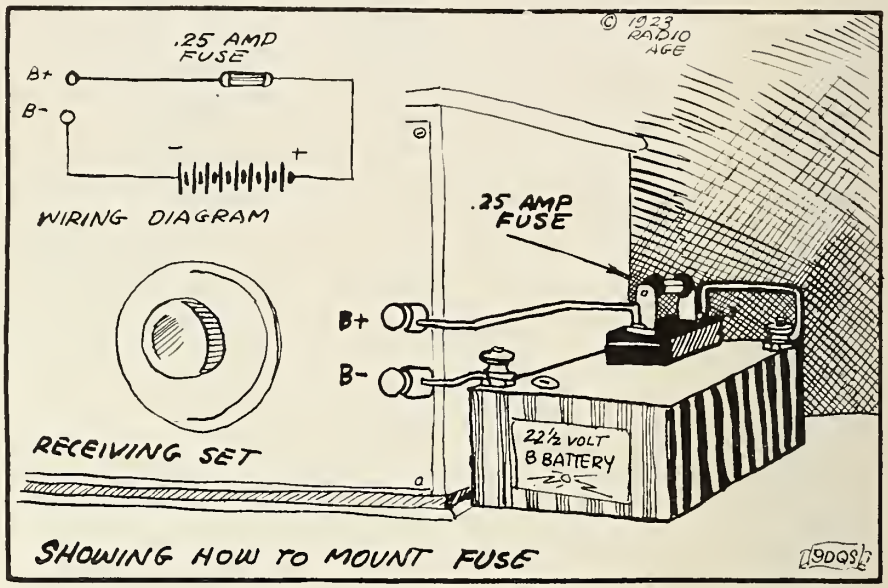
By May 15, the nine radio inspectors of the Department will also undertake the reallocation of specific waves to old Class A or new Class C stations in his district now operating on 360 meters. These wave lengths, between 222 and 300 meters, will not be exclusive nationally but will be exclusive in each radio district, giving practically every station a selective wave. Along the borders of adjacent districts, inspectors plan to arrange the allocation of wave lengths so that no material interference will be created due to the assignment of waves in close proximity.

Class C stations now licensed on 360 meters will be permitted to continue the use of this wave length if they so desire, but they will not be permitted to vary the wave length.

The reallocation means much to fans, all of whom should be able to pick up any B station and any of the A stations in his district due to the allotment of many additional waves.

A great amount of additional work will fall upon the shoulders of the radio inspectors and unless the receiving public, operators and other interests co-operate staying on wave lengths assignment, the work will be delayed and interference will not be overcome for some time.

Details of committees' recommendations are printed elsewhere in this issue.



Fusing the "B" Battery

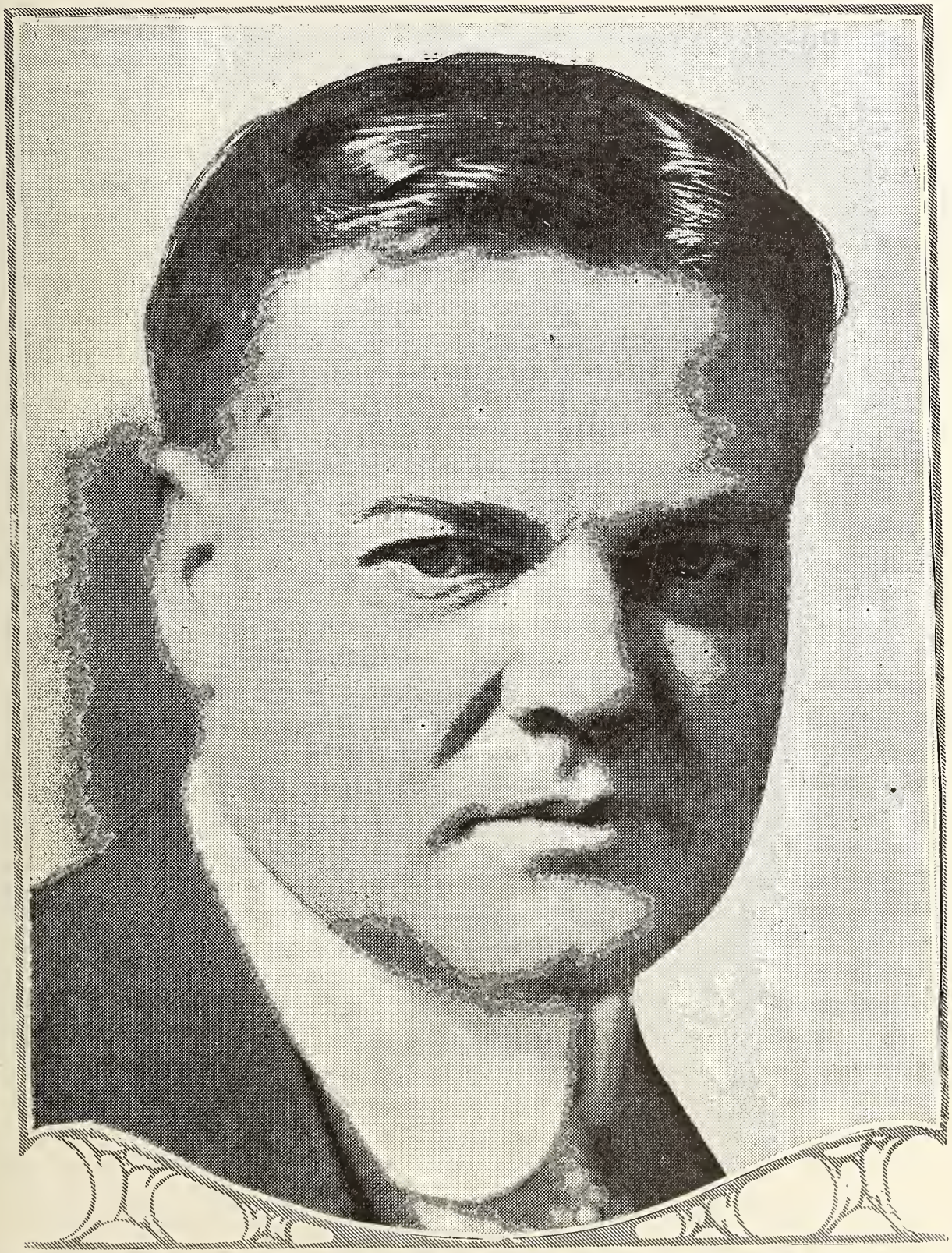
In using both "A" and "B" batteries on the receiving set, one cannot be too careful about getting them connected to the proper terminals when installing the set. Sometimes the binding posts on the cabinet are not marked and it is a very easy matter to make a mistake in the connections. If the "B" battery is so connected that it gets to the filament terminals, the filament will be destroyed, unless the circuit is protected in some way.

Then also, it quite often happens that the wires in the set become accidently crossed, which will often throw the current from the "B" battery into the filament. A small fuse having a capacity of about 1-4 ampere, inserted in the positive side of the "B" battery circuit, as shown in the drawing will often save the cost of a new set of tubes. If W-D-11 tubes are used, the fuse should have a carrying capacity of only 1-8 ampere.

Amplifying circuits using high pressures of from 65 to 150 volts can be well protected by inserting an ordinary 25 watt, 110 volt lamp in the circuit of the "B" batteries. The resistance of such a lamp is high enough to prevent too much current flowing, in case of a temporary cross, and at the same time is low enough, not to interfere with the amount of current necessary to supply the plate circuit.

"Chief Justice" Hoover of Radio

By CARL H. BUTMAN



WASHINGTON, D. C.—Following in the leads of the great outdoor sport and the old favorite evening pastime, radio may take on an arbitrator. Just as Landis has come to have the "last word" in base-ball, and Hayes to write the "finale" of the movies, so Hoover may soon transmit "VA," the "30" of radio, putting an end to all arguments in the ether.

In calling the recent radio conference, Herbert Hoover offered not only to arbitrate radio disputed, but to make the necessary regulations which the Senate failed to provide. He has volunteered as a sort of foster father to this new art and industry, and hopes to clear up a threatening atmosphere charged with static. The conference just terminated indicated whole hearted

voluntary support by the several phases of the industry of an administration by him. It only remains for the radio public to co-operate to offset a threatened slump and remove the present broadcasting interference. Incidentally, Hoover's administration in his present capacity would save the industry the cost of a privately paid arbitrator.

In the opinion of Major General George O. Squier, Chief Signal Officer of the Army, than whom radio has no more earnest supporter nor more generous technical contributor, the industry and public should co-operate with Hoover in his every wish.

"The failure of the Senate to pass the White Bill may be a blessing, although we all were disappointed at the time," General Squier said to the writer during the conference. The very lack of law requires a closer co-operation of the various radio activities in order to straighten out difficulties and combat interference, he explained. Co-operation is assured through the fact that manufacturers, engineers, broadcasters, commercial interests and amateurs have voluntarily subscribed to a wave length distribution and agreed to abide by such regulations as Secretary Hoover lays down as necessary. This indicates, he pointed out how close the great family can be brought together when necessary.

The inventor of "Wired-wireless" emphasized the great benefit to radio of a period of unhampered development and operation under voluntarily accepted regulations, instead of hard and fast laws, which could only be remedied by the passage of other laws dependent upon the action of a rather dilatory Congress. Changes in regulations found necessary during a year of such operation could be applied immediately, without reference to Congress.

"The art is advancing so rapidly that we hardly know what to expect next," General Squier said; "to-day radio is a service for the ear, but if the transmission of radio pictures—still and moving—is perfected, the eye may also be served." We must be ready to accept new views and apparatus at a moment's notice; not to do so would place this country in the rear instead of the van of radio progress," he indicated. Since the White Bill was drafted, General Squier said, many new phases had arisen which indicated that the bill was not entirely suitable.

"Secretary Hoover," the General said, "has practically volunteered to administer and arbitrate radio troubles for at least two years—free." As a Cabinet member, his service to the radio interest will not cost a cent, he explained, pointing out that the moving picture industry had found it necessary to secure the services of a former member of the Cabinet at a sum reported to approach $100,000 a year, and that baseball likewise had a highly-paid arbitrator.

Conflicts or difficulties arising between operators or stations can upon recommendation by Hoover's Advisory Committee be adjusted quickly without reference to a court of law; new regulations can be instituted without delay and harmonious operation can be maintained between the thousands of transmitting and millions of receiving stations which now spread over the face of the country.

Backing Hoover is an opportunity that the radio industry and public cannot afford to neglect, General Squier believes.

Recommended Wave Allocations

It is recommended that radio stations be assigned specific wave frequencies (wave lengths) within the wave band corresponding to the service rendered as given in the following table.

Throughout this report, both wave frequency and wave length are given. Wave length in meters is 300,000 divided by wave frequency in kilocycles per second.

It is recommended that wave bands marked exclusive be used for no other type of service; those marked non-exclusive can be used for other types of radio communication, as indicated.

Wave Frequency, Kilocycles per second.	Wave Length, Meters.	Service.
Above 2300	Below 130	Reserved. (See Note 1.)
2300	130	Government, CW, exclusive.
(2300	130)	Reserved. (See Note 1.)
(2100	143)	
2100	143	Government, CW, exclusive.
(2100	143)	Reserved. (See Note 1.)
(2000	150)	
(2000	150)	Amateur, CW, ICW, Ph. exclusive.
(1700	176)	Amateur, CW, ICW, Ph. Spk, exclusive.
(1500	200)	
(1500	200)	Special amateur, and technical and training schools, CW, exclusive.
(1350	222)	
(1350	222)	Aircraft, CW, ICW, Ph., non-exclusive.
(1300	231)	
(1350	222)	Class B broadcasting, Ph, non-exclusive.
(1050	286)	(See Note 2.)
(1050	286)	Reserved.
(1040	288)	
(1040	288)	Class A broadcasting, Ph, exclusive.
(1000	300)	(See Note 3.)
1000	300	Marine, CW, ICW, Spk, non-exclusive.
		(See Note 4.)
(1000	300)	Class A broadcasting, Ph., exclusive.
(667	450)	(See Note 3.)
667	450	Marine, CW, ICW, Spk, exclusive.
		(See Note 5.)
(667	450)	Class A broadcasting, Ph, exclusive.
(550	545)	(See Note 3.)
(550	545)	Marine and aircraft, CW, ICW, Spk, exclusive.
(500	600)	
500	600	Marine and aircraft, CW, ICW, exclusive.
		(See Note 4.)
(500	600)	Marine and aircraft, CW, ICW, Spk, exclusive.
(445	674)	
445	674	Government, CW, non-exclusive.
(445	674)	Marine and aircraft, CW, ICW, Spk, exclusive.
(375	800)	
375	800	Radio compass, CW, ICW, Spk, exclusive.
(375	800)	Marine, Ph, exclusive.
(315	952)	
315	952	Government, CW, ICW, Spk, exclusive.
(315	952)	Reserved.
(300	1000)	
300	1000)	Radio beacons, CW, ICW, Spk, exclusive.
(300	1000)	Reserved.
(285	1053)	
(285	1053)	Marine, Ph, exclusive.
(275	1091)	
275	1091	Government, CW, ICW, non-exclusive.
(275	1091)	Marine, Ph, exclusive.
(250	1200)	
250	1200	Government, CW, ICW, non-exclusive.
(250	1200)	Marine, Ph, exclusive.
(235	1277)	
(235	1277)	University, college, and experimental, CW, ICW, exclusive.
(230	1304)	
(230	1304)	Government, CW, ICW, Spk, exclusive.
(190	1579)	
(190	1579)	Marine and point-to-point, non-government, CW, ICW, Spk, exclusive.
(120	2500)	
(120	2500)	Government, CW, ICW, Spk, exclusive.
(95	3158)	

Note 1.—Available for special licensing by the Department of Commerce.

Note 2.—Not more than six CW amateur stations to be licensed to use wave frequencies above 1,050 kc/s (wave lengths below 286 meters), for communication across natural barriers.

Note 3.—A class A broadcasting station is a station of sufficient power to serve an extensive territory. Fifty territorial wave frequencies approximately 10 10 ko/s apart are to be assigned by the Department of Commerce to local areas throughout the United States without duplication. The ten such areas within each of five national zones are to have wave frequencies separated by approximately 50 kc/s.

Note 4.—The 1,000 and 500 kc/s (300 and 600 meter) waves are for calling and distress purposes, with a minimum of traffic.

Note 5.—Mobile service on the 667 kc/s (450 meter) wave is to be stopped between 7 and 11 p. m. local standard time, and to be transferred in so far and as soon as practicable, to wave frequencies below 500 kc/s (wave lengths above 600 meters)

Send $1.00 to Radio Age, 500 North Dearborn Street, Chicago, and receive this middle-west radio periodical for six months. Regular subscription price is $2.50 a year.

The Handy Radio Co., of Moravia, has issued a chart by which names, locations and time schedules of the principal broadcasting stations are presented on one sheet. It is a compact index. Patent rights have been applied for.

The Bureau of Standards will shortly issue Letter Circular 87 entitled "Methods of Measuring Properties of Electron Tubes." It is a technical paper intended to advise manufacturers and engineers how the Bureau makes its tests.

Radio Conference Recommendations

SECRETARY Hoover makes the following announcement:

The recommendations by the Radio Conference represent a step in ideal development of measures for the prevention of interference in public broadcasting.

The report recommends making available all wave lengths from 222 to 545 meters for public broadcasting, the various possible bands to be assigned to different stations so as not only to reduce direct interference but also to build up zonal regions of distribution.

The Department fully accepts the recommendations of the Conference, but there are a number of difficulties in placing the plan abruptly into action: First, the hardship that it may cause to various stations to move arbitrarily to new wave lengths; second, the difficulties introduced by the ship to shore communication which are now workng to some extent on 300 meters and also on 450 meters.

The Conference recommended that the ultimate development for ship communication be to assign for the general purpose of shipping the whole wave area from 600 to 800 meters, different bands being allotted within this area for different shipping purposes. The distress signals from ships now work on 600 meters and the radio compass works on 800 meters. The ship to shore communications on 300 and 450 meters are altogether commercial traffic and would be more advantageously carried on with less interruption than to-day if these services were given the entire field around 700 meters.

In order to make progress in this direction of developing the area from 600 to 800 for ship communication, it is proposed that all ships and all shore stations used for ship communications shall cease using 450 meters between the hours of 7 and 11 p. m., but may use 700 meters at this or any other time. The 300 meters wave length now assigned under the International Convention is very little used and will be used for inland broadcasting, and it is not expected that the ships will avail themselves of the International Agreement in this particular, as it has not proved of practical advantage except to a limited extent.

For internal broadcasting the Department proposes to cooperate with the various stations with a view to developing a systematic assignment of wave lengths to the various stations within the broad confines of the recommendations of the Conference. In order to carry this out without hardship the following classification of stations will be made:

Class A stations—that is, stations equipped to use power not exceeding 500 watts. In this class it is proposed that the radio inspectors, in co-operation with the station owners, shall assign distinctive wave lengths to each station so far as is possible in the area from 222 to 300 meters. No station will be required to change from 360 unless it so desires.

Class B stations—that is, stations equipped to use from 500 to 1000 watts. In this class it is proposed to similarly offer to license these stations on special wave lengths from 300 to 345 and from 375 to 545 meters, having regard to the maintenance of some ship work on 450 meters as outlined above and again no station will be required to change from 360 unless it so desires.

Class C stations—comprising all stations now licensed for 360 meters. In this class no new licenses will be issued for stations on 360 meters until the plan is entirely realized. Stations which do not wish to move under the general plan may remain at 360 meters, but they will necessarily be subject to some interference at best. It is thought that by the above plan the stations can be gradually brought into accord without hardships.

Under the plan amateurs are given the whole area from 150 to 220, instead of being fixed upon 200 with special licenses at 375. The special licenses hitherto issued for amateurs at 375 will now be issued at 220. Certain special cases will be taken care of otherwise. It is proposed, in cooperation with the amateur associations, to develop an assignment of wave bands in classifications so as to somewhat relieve the present interference among amateurs. It will be remembered that the number of wave bands which can be used among the short wave area assigned to the amateurs is greater in proportion than among the longer wave lengths, and these arrangements expand the area hitherto assigned to amateurs.

The full recommendations of the Conference are published herewith, the recommended allocation of wave lengths

(*Continued on page 12*)

New Wave Lengths

The following announcement of the Department of Commerce, naming the wave lengths of broadcasting stations by cities is the keynote of the arrangement by which interference, it is hoped, will be eliminated:

By Dept. of Commerce.

The specific wave lengths indicated are in accordance with the plan sent to Radio Inspectors following the recommendations of the Second National Radio Conference. The Radio Inspectors have been instructed to communicate the plan to stations in their districts. Every station which the Department has so far heard from has willingly fallen in with the plan. Of course, it is understood that any station now operating on 360 meters has the privilege of remaining on that wave length.

(NOTE) It is to be noted that assignments are for cities and not for specific stations.

Wave lengths marked "Reserved" are being held for localities in the zones where Class B stations do not exist at the present time.

Allocation of Wavelengths.
Class B—Stations Operating and Pending.

	Frequency Kilocycles	Wavelength Meters
Zone 1.		
Springfield, Mass. / Wellsley Hills, Mass.	890	337
Schenectady, N. Y. / Troy, N. Y.	790	380
New York City & Newark, N. J.	740	405
	660	455
	610	492
Philadelphia	590	509
	760	395
Washington, D. C.	690	435
Reserved—303—319—469—(357)—(288)		
Zone 2.		
Pittsburgh, Pa.	920	326
Chicago, Ill.	670	448
Davenport, Iowa / Des Moines, Iowa	620	484
Detroit, Mich. / Dearborn, Mich.	580	517
Cleveland, Ohio / Toledo, Ohio	770	390
Cincinnati, Ohio	970	309
Madison, Wis. / Minneapolis, Minn.	720	417
Reserved—(294)—345—(366)		
Zone 3.		
Atlanta, Ga.	700	429
Louisville, Ky.	750	400
Memphis, Tenn.	600	500
St. Louis, Mo.	550	546
Reserved—300—316—(353)—375—462—333.		
Zone 4.		
Lincoln, Neb.	880	341
Kansas City, Mo.	730	411
Jefferson City, Mo.	680	441
Dallas, Texas. / Fort Worth, Tex.	630	476
San Antonio, Tex.	780	385
Denver, Colo. (Reserved)	930	323
Omaha, Neb.	570	527
Reserved—(361)—(291)—306.		
Zone 5.		
Seattle, Wash.	610	492
Portland, Ore.	660	455
Salt Lake City, Utah	960	312
San Francisco, Calif.	590	509
	710	423
Los Angeles, Calif.	760	395
	640	469
San Diego, Calif.	560	536
Reserved—(297)—330—(349)—(370)		

Radio Conference Recommendations

(*Continued from page 11.*)

being published in a separate table.

Conference Report

This conference was called by Secretary Hoover to consider what can be done from an administrative point of view to lessen the amount of interferences in radio broadcasting. The meetings were held at the Department of Commerce on March 20 to 24, 1923.

Resolutions

That this conference, and the Department of Commerce subsequently, follow the practiceof expressing wave frequency in kilocycles per second, with wave length in meters in parentheses thereafter.

That in assigning a wave band of 10,000 cycles to each Class A broadcasting station they be distributed over five zones throughout the country such that no stations in adjacent zones are closer together in frequency than 20 kilocycles, and that within each zone there be ten stations separated by 50 kilocycles.

That only one wave frequency be assigned to a Class A broadcasting station, which should transmit exclusively on the wave frequency designated and reserved exclusively for that station.

That every broadcasting station should be equipped with apparatus such as a tuned circuit coupled to the antenna and containing an indicating instrument or the equivalent for the purpose of maintaining the operating wave frequency within 2 kilocycles of the assigned wave frequency.

That the Department of Commerce establish qualifications for Class A broadcasting stations, including a general minimum and locally suitable maximum power and a quality of program that will warrant assignment of a territorial wave frequency to each particular station, and that the qualifications be similar to those required of the present class B broadcasting stations.

That the Department of Commerce in its discretion assign Class B broadcasting station licenses in which wave frequencies shall be specified and in which the power ratio between the Class A and B stations shall be at least 2 in so far as is practical for a given locality.

That in granting licenses it is recommended that the Department of Commerce limit the use of power where undue interference would otherwise be caused.

That reading of telegrams or letters by broadcasting stations be not construed as point to point communication so long as the signer is not addressed in person and so long as the text matter is of general interest.

That simultaneous re-broadcasting shall be permitted only on a broadcasting wave frequency, and with the authorization of the original broadcaster and of the Department of Commerce.

That the Department of Commerce be requested to insist upon the suppression of harmonic and other parasitic radiation from all radio stations, as for example, by requiring the installation, if necessary, of coupled circuit transmitters at the earliest feasible date.

That spark transmitting apparatus be replaced as rapidly as practicable by apparatus which will produce a minimum of interference.

That the amateur organizations of the United States study the time requirements of the broadcasting of religious services on Sunday and by mutual arrangement with the broadcasters determine upon silent periods which will make possible the reception of such religious services in any given locality.

That when the government conducts services similar to commercial services for which waves or wave bands have been assigned, the government stations shall use the said waves or wave bands.

That the Government have the exclusive use of a band one kilocycle wide centered at each of the following frequencies, 92, 83, 81, 78, and 76 kilocycles, so far as is consistent with public service generally.

That where a line-radio installation produces interference with the reception of signals from beyond the state such line-radio station shall require a license from the Department of Commerce.

That the subject of interference caused by devices not used for radio communication purposes and which are not subject to the present radio law be referred to the projected Sectional Committee of the American Engineering Standards Committee and that in the meantime the members of the conference offer to the Department of Commerce their cooperation in the solution of such immediate problems as may be of a character in which their aid could be of value.

That, in the judgment of the Second National Radio Conference, the prevention of "wilful or malicious interference," as provided for by Section 5 of the Act of August 13, 1912, and the minimization of interference, as provided for by Article 8 of the International Convention, require that the Department of Commerce shall, in its discretion, withhold or rescind station licenses to transmit on specified wave frequencies, at certain times, and on definite powers, and with certain types of transmitters and when, in the judgment of the Department of Commerce such interference would result or does result; and that it is the clear and manifest intent of Section 1 through 4, and Regulations 10, 12 and 18 of Section 4 of the said Act to give the Department of Commerce such authority to withhold or rescind licenses where such interference will result or does result; and that the Second National Radio Conference believes that a decision by the Courts validating the above views will be greatly in the public interest; and that the Second National Radio Conference expresses its willingness to advise and assist the Department of Commerce in the support of the above resolutions in the event of litigation.

That a copy of the foregoing motion be sent to each concern, organization or association engaged in manufacture of radio equipment, or broadcasting by radio or otherwise interested in radio communication with a request for an expression of approval or disapproval of the motion and an agreement to abide by its provisions.

That the Second National Radio Conference desires to emphasize the limited facilities available for radio broadcasting, and the uneconomic and tentative basis of present-day broadcasting, and that the Conference urges the consolidation in each locality of those desiring the establishment or maintenance of broadcasting and those interested in broadcasting in that locality; to the end that broadcasting conducted in each neighborhood by such a local association will receive public support and be handled in an economic and permanent fashion.

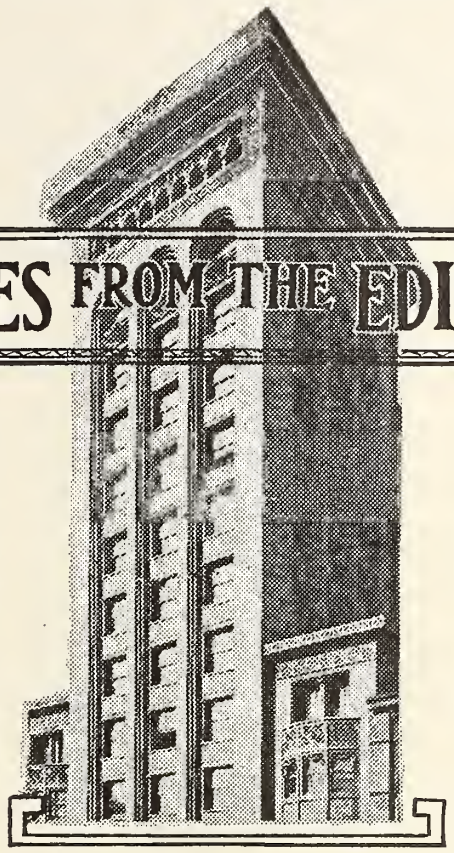
That the great expansion of radio communication has not been accompanied by a proportional increase in the radio personnel and facilities at the disposal of the Bureaus of Navigation and Standards of the Department of Commerce, and that the resulting strain on the inspection and technical forces of the Department of Commerce has been excessive, and has even forced the omission of important activities and investigations, and that the Second National Radio Conference strongly recommends that additional appropriations be granted to the Department of Commerce for its radio inspection personnel and equipment and for its research personnel and facilities. That a committee of three be appointed to wait upon the Secretary of Commerce to present the urgency of this need and the importance of the early provision of funds for these Bureaus.

That the present conditions of radio interference with non-local reception and the resulting public dissatisfaction urgently require that the recommendations of the conference be accepted by the Secretary of Commerce and put into early operation by the Department of Commerce.

One-Year Licenses

One of the first things to be done by the Department of Commerce will be the extension of the license periods for broadcasters, from three months to a year. Since the introduction of the White Bill last June, the Department has been extending broadcasters licenses every three months on application, in anticipation of new regulations which would have followed closely upon the enactment of new laws. But the failure of the Senate to pass the Radio Bill precludes new legislation for at least a year and twelve-month licenses will now be issued to save the Department time and work.

There are about four times the operators licenses issued annually today, compared with those issued in 1913. Ten years ago, only 3,682 operators were licensed but in 1922 operators licensed totaled 12,113. Commercial licenses issued increased about 80 per cent, and amateurs licenses were nearly eight times as many. There were issued in 1922, 8,920 amateur licenses, and in 1913 only 1841.



THOUGHT WAVES FROM THE EDITORIAL TOWER

LET us not get excited over the fact that several very rich corporations have agreed to pay royalties to the American Society of Composers and Authors and Publishers for the privilege of broadcasting copyrighted music from stations controlled by those rich corporations.

Broadcasting stations can parry this blow at popularized radio in a very simple way if they will. It is not necessary to stop broadcasting music and it is not necessary to pay the tax.

Some broadcasters declare they already are under heavy expense and are absolutely unable to pay the tax demanded. They get no money for entertaining millions of radio fans and they have asked for none. Quite a considerable number of stations are paying from $50,000 upward annually for the maintenance of their programs.

The writer has a vision of radio that apparently the responsible heads of the authors and composers have not. It is a vision of a nation of people who are becoming radio lovers and who will not easily be deprived of their evening concerts. It is a vision of a great army of radio enthusiasts including many musicians of ability and even genius.

Then how may the broadcasting of good music be maintained? Here is the answer:

Broadcast the Facts

Let the broadcasting stations make it known to the radio public that the American Society that controls copyrighted music now in vogue is taking a step that will tend to cut off popular musical entertainment in a majority of the stations—that is in those stations unable or unwilling to pay the tax demanded. Then let the stations make an appeal to composers and song writers. Many of them are radio fans. Many of them, for the love of radio, and as a graceful act of disinterested benefit to the millions of other fans, wou'd be willing to dedicate a piece of original music or a song to the radio cause.

Not all the musical talent in the United States is represented around Forty-second and Broadway. The jazz tunes of today and the songs of the present hour will be forgotten tomorrow. They are not indispensable. Authors and composers are compelled to face the truth of the old saying, just as others recognize its truth—"nobody is ever missed."

Volunteer song writers and composers of music could copyright their productions and give a release to broadcasting stations that wished to popularize them by radio transmission. An arrangement could be made whereby the National Broadcasters' League, the largest organization of its kind in the world, would publish and distribute such songs and music to broadcasters and then place the songs and music on the market which such broadcasting surely would establish.

Would Pay Royalties

The song writers and composers would receive their royalties on sales as a material recompense and it would not be difficult to induce broadcasters to mention the name and address of the song writers and composers before and after each musical number. That would win fame. It would mean tremendous advertising for the song writers and composers but it would be within the present broadcasting regulations. And it would save popular music for the radio millions!

Until new music is available the stations can get on very well with the old songs, the old melodies and the beloved classics. We haven't been getting enough of them anyhow.

What do the broadcasters think of this plan? Can they offer any improvements on it? Do they believe it to be desirable and necessary?

What do the music lovers and music producers in radio think of the suggestion?

If you have a thought on the subject, either for or against it please address a letter to the secretary of the National Broadcasting League, 500 North Dearborn Street, Chicago, Illinois.

THE AMERICAN Society of Composers and Authors tried to steal a march on the Broadcasters at the recent second annual National Radio Conference in Washington. The American Society of Composers and Authors has been trying to extort from the broadcasters a generous fee in return for the broadcasting of copyrighted music and songs. Up to date the demand for payment of such a tax has been met with unanimous refusal.

So when the Department of Commerce was holding its radio conference a representative of the Composers and Authors asked that the Department prohibit stations from using copyrighted music and songs unless fees were paid. To this the Department replied that the Government might as well be asked to force the stations to pay rent and to compel the payment of fees for the use of patented radio apparatus. It was decided at this conference that if the composers and authors want these fees badly enough they must go to court.

It is interesting in connection with this to point out how small the return is financially to the broadcaster for his service in entertaining the public. Mr. Howard E. Campbell, radio engineer, told the conferees that the Detroit News, which he represented at the conference, spends $100.000 annually for its radio activities. Mr. Campbell said that the only return made to the newspaper for this expense was "good will."

Cuba Loses Freedom

"Cuba Libre" may again become a national slogan, if the restrictions placed on public radio operation interfere too much with the independence and pleasure of Cuban radio fans.

There have been no laws or regulations covering either the construction or operation of radio stations in Cuba, until a recent presidential decree divided non-governmental radio stations into five classes, assigning wave lengths and power maxima. All classes of stations —including private receiving sets—were required to be registered prior to March 16; operators licenses are now necessary and bad apparatus is banned.

The decree which will serve until a pending radio law is enacted, provides for the classification of all except commercial and governmental sets as follows:

Class	Wave length (meters)	Maximum power (kilowatts)
A—Amateurs, including all receiving sets	200	1/2
B—Educational institutions and Experimenters	225–275	1/2
C—Colleges & State Institutions	300–360	1/2
D—State institutions only	400	1/2 to 1
E—Meterological stations only	485	1/2 to 1

*All receiving sets are rated Class A, regardless of type or size.

All owners of stations within these five classes were ordered to register with the Director General of Communication. After March 16, no station may be used unless the proper permit has been issued. The permits are for a term of one year in the case of Classes A, B, and C, and for five years in the other two classes. Applicants must pass an elementary examination, but it is not believed that this requirement will hamper the issuance of licenses. The Government may, under specified circumstances, require transmitting stations of any of the five classes to cease operation without claiming indemnity.

Transmitting stations of all classes are subject to the regulations of the International Radio Convention signed in London in 1912. The decree prohibits the transmitting of the international distress call "S. O. S." Penalties are provided for the disclosure of any public or government message intercepted by station. Only apparatus capable of transmitting a pure, continuous wave may be used, and the frequency must be constant so as to avoid oscillation.

First Aircraft Licenses

Radio as a safety measure for the protection of pilots and passengers has come into its own in air travel as well as on the sea, where its value was first realized. Seven airplanes and flying boats now are equipped with radio and answer regular calls.

The first American aircraft, other than those of the Army and Navy, which are all radio-equipped but not licensed, to be licensed as a limited commercial station was one belonging to the Airline Transportation Co. of California. The Aeromarine Company followed with the "Buckeye" in December and licensed five more recently. Radio-equipment, officials believe, will make for greater safety in over-sea travel and insure aid when air boats are forced down.

Aircraft Licensed as Limited Commercial Stations on 525 Meters.

KFBI, Airline Arrow, No. 1, Airline Transportation Co., Los Angeles, Calif., August, 1922.

KFBY, Balboa, Aeromarine Airways, Inc., New York City, January 18, 1923.

KFBA, Buckeye, Aeromarine Airways, Inc., New York, December 22, 1922.

KFBF, Gov. Cordeaux, Aeromarine Airways, Inc., New York City, January 18, 1923.

KFBJ, Nina, Aeromarine Airways, Inc., New York City, January 18, 1923.

KFBM, Ponce de Leon, Aeromarine Airways, Inc., New York City, January 18, 1923.

KFBZ, Santa Maria, Aeromarine Airways, Inc., New York City, January 18, 1923.

Panama Stations

An agreement with the Panama Government places the control of all radio in the Canal Zone or in the Republic of Panama under the United States, and the Navy acts for the Government. Panama would like to break this treaty, it is said, and either set up stations of her own or let commercial concessions open stations there. Broadcasting and radiotelephony have accentuated this, and commercial companies desirous of selling their equipments are no doubt behind some of these activities. In order to gratify local desires and to "loosen up" a little on regulations, the Navy has authorized the stations in the Zone to broadcast entertainment programs.

Denver to Haiti

Station KFAF, George S. Walker, owner, claims a long distance record as having been received by an operator in Port Au Prince, Haiti. KFAF has been heard in every state in the union, in Hawaii, in Sitka, Alaska, Cuba, Old Mexico, New Brunswick, Canada and by ships in the Atlantic and Gulf waters. It has been heard also by ships far out in the Atlantic Ocean. It is one of the big privately owned stations that is making good and it is extremely popular.

A new edition of the International List of Radio-telegraph stations will soon be ready for distribution, the Department of Commerce has been advised. Copies of this, the 8th edition, can be secured by addressing the International Bureau of the Telegraph Union at Berne, Switzerland, for fourteen francs Swiss.

Germans Pay

In Germany, radio fans, most of whom are bankers and business men have to pay 500,000 marks annually for their radio broadcast service.

A financial and commercial news service has been arranged for broadcasting by the Express Service Company of Berlin, according to information reaching Washington. This private company, financed by Germans, has just secured partial use of the Koenigswusterhausen radio station from the Government for broadcasting international news received via Nauen from the United States, Switzerland, Sweden and other countries.

The news is re-broadcast over a radio phone circuit for about 800 subscribers, principally banks and industrial institutions, in about 200 cities. The company plans to handle New York quotations within ten minutes after their dispatch from this country.

Subscribers rent their receiving sets from the express company, paying an annual rental charge of 200,000 marks and an annual service charge of 300,000 marks. Two and a half hour schedules are maintained every morning and evening.

Lady Bountiful

Radio reception has been greatly simplified in Backus, Minnesota. If the Backus resident is a telephone subscriber he just takes his telephone receiver from the hook and music, drama, sermon or lecture pour out. He has no need to worry about rundown batteries, weak tubes, the intricacies of hook-up or the length or height of his antenna.

Miss Anna Ozier, chief operator for the Backus Telephone company recently wrote WGY, the radio broadcasting station of the General Electric Company, at Schenectady, as follows:

"We have a receiving station here and by putting the horn close to the transmitter and connecting up the farm lines, I have a system now by which the subscribers on our farm lines who have never had an opportunity of getting concerts direct from the air have passed many of these winter evenings enjoying themselves by turn and turn about at the telephone.

"I know of several cases where three or four people have listened in on the same receiver at once. In one case I was surprised by being materially recompensed by a lady who was so much pleased by the concert and the part she thought I took in it, that she brought me a dozen eggs. As she said, it was her way of saying 'thank you'."

Someone has suggested the name of "Radiowners" for those of us who have sets and listen in. Certainly it is better than most of the awkward terms in use today. "Listeners-in" is too long, "Radiophans" or "Radiofans" sounds like the name of an instrument, and we could hardly designate them as "receivers."

The Monthly Service Bulletin of the

NATIONAL BROADCASTERS' LEAGUE

Solely by, of and for Radio Broadcasting Station Owners

George S. Walker
Western Radio Corporation
Denver, Col.
President

Arthur E. Ford, E. E.
State University of Iowa
First Vice President

W. J. Baldwin, W S Y
Alabama Power Co.
Birmingham, Ala.
Second Vice President

Frederick A. Smith
Garrick Building,
Chicago
Secretary

Founded to promote the best interest of Radio Broadcasting stations in the United States and Canada.

Executive Offices, Garrick Building, Chicago, Ill.

DIRECTORS:

T. W. Findley, W L A G
President and Genl. Mgr
Findley Electric Co.
Minneapolis, Minn.

Earle C. Anthony, K F I
Earle C. Anthony, Inc.
Los Angeles, Cal.

J. Elliott Jenkins, W D A P
Midwest Radio Central, Inc.
Drake Hotel, Chicago, Ill.

Howard E. Campbell, W W J
The Detroit News,
Detroit, Mich.

H. A. Trask, K S D
St. Louis Post Dispatch
St. Louis, Mo.

Stanley O. Need, W G A H
The New Haven Electric Co.
New Haven, Conn.

A. J. Westland, W W L
Physics Dept. Loyola University
New Orleans, La.

Frank W. Elliott, W O C
Palmer School of Chiropractic
Davenport, Ia.

During the month of March, broadcasters increased to 609, but twenty-nine withdrew and their licenses were cancelled, leaving, with twenty-one new stations licensed, a total of 580 operating stations. Of these, thirty are Class B stations on 400 meters and the balance on 360 meters. There they will remain until applications for transfer to the two new classes are received and they are "sorted" out and assigned new waves by the Department.

A step to eliminate interference between broadcasting stations was taken when the Power Staggered Wavelength Broadcasting Plan was presented by the National Radio Chamber of Commerce to the Hoover conference meeting in Washington to solve broadcasting difficulties.

Briefly, the plan contemplates the use of three major bands of wavelengths. Broadcasting would be divided into three main divisions according to the type of program furnished. Programs covering lectures, talks, reports, etc. would be broadcast on a particular wavelength band. Classical musical programs would be broadcasted on another wavelength band, while popular musical programs would be confined to still another wavelength.

In addition to this assignment of wavelength bands, the country would be divided into Broadcasting Districts. Broadcasting stations would operate simultaneously on the three major wavelength bands above mentioned. The plan has been so worked out that there is ample variation in wavelengths and no two broadcasters will interfere with each other. In fact three broadcasters may operate simultaneously in one district without interference as well as several other broadcasters in accordance with the time Schedule arrangements. The idea back of the whole plan is to give the public what they want when they want it. The receiving sets are tuned to the program desired.

The plan as recommended by the National Radio Chamber of Commerce was originated by Harold J. Power, of Medford Hillside, Mass. Mr. Power is Vice-President of the American Radio and Research Corporation. He was a pioneer in the development of radio, and has devoted much of his time to study of the broadcasting situation.

The following letter was received from the Standard Radio Equipment Co., of Fort Dodge, Iowa. (WEAB)

March 15, 1923.

Gentlemen:

We are wondering if something can be worked out amongst the various broadcasting stations whereby emergency traffic can be handled in better shape than we handled it Monday and Tuesday of this week. (March 11-17.)

Approximately the entire wire service throughout the state of Iowa was demoralized, and Station WGF at Des Moines, WOC at Davenport, and our own Station attempted to handle the traffic and while communication between ourselves and Des Moines was excellent and we worked on a schedule, we seemed to be unable to get any satisfactory arrangement with WOC at Davenport, who were the connecting link to Chicago, and the result was that we put most of our traffic to an amateur at Clinton, Iowa.

While it is not the function of the broadcasting stations to handle this service, we believe that the Broadcasters League should work out with the assistance of the various broadcasting stations a regular relay route which can be used in cases of emergency, and have it understood amongst the various stations as to whom they shall work with in all directions.

Yours very truly,
STANDARD RADIO
EQUIPMENT COMPANY.

Station WOC, operated by The Palmer School of Chiropractic, Davenport, Iowa, did some splendid work in assisting the railroad, telephone and telegraph companies in transmitting important dispatches after the serious sleet and snowstorm which disrupted communication throughout the Middle West in March.

All programs were abandoned on Monday and Tuesday, and Station WOC devoted the time to transmitting messages for the railroads in locating "lost" trains and train dispatches, to sending messages for the telephone company to other headquarters to get repair men and supplies, and sending messages relating to sick-

OWNERS of broadcasting stations who have not yet joined the National Broadcasters' League, may do so by sending their check for the annual membership fee of $10 to Frederick Smith, Secretary, 500 N. Dearborn St., Chicago.

Membership will entitle broadcasters to periodical information as to developments in connection with broadcasting, intelligence as to steps taken to eliminate the present almost disastrous interference and news of events in any part of the country affecting broadcasting and broadcasting interests. Also members will receive the official organ of the league for one year.

This nominal fee is required for the cost of issuing circulars and handling the large volume of correspondence. You will find it useful to be associated directly with this clearing house for broadcasting information, which is also a protective institution, offensive and defensive.

ness and death for telegraph companies to stations they could not reach because the wires were down.

One instance showing the quick results from radiophone, picked at random, was a message sent from Fullerton, Calif., to a man in Illinois, stating that his father had died. The message got as far as Davenport over the wires, but had to be relayed by radio from there. Within fifteen minutes of the time it was broadcast a local party phoned the station that the party was in a Davenport hospital, and the sad news of his father's death was conveyed to him.

Washington's New Station

Practically the whole continent will be able to hear a new broadcasting call, as yet unassigned, when the RCA station at Washington opens up in June. Other than that the station will be of the highest order and latest type, the Radio Corporation refuses to state. Judging from rumors, however, its voice should reach to every corner of the country as well as some of the insular possessions.

The new station is located at 14th St. and Park Road, known in Washington as Mount Pleasant.

Through the co-operation of the Riggs National Bank and Chas. H. Tompkins, two one-hundred foot fabricated steel towers have been erected on the roofs of the Riggs and Tompkins Buildings in the highest section of Washington where they will serve as new and modern landmarks for the Capital.

The towers, tapering networks of steel, have a slight curvature which will give them somewhat the appearance of small Eiffel towers. Their construction is unusual, in that they have three legs instead of the more customary four. This reduces wind resistance and makes for stability. A thirty-six foot cross-arm near the top of each tower supports four antenna wires each twelve feet apart. The distance between the towers is two hundred twenty feet and the effective radiating length of the antenna one hundred sixty feet.

The studio, the reception, transmitting and apparatus rooms are on the second floor of the building. Two motor generator units will insure an adequate power supply and two tube transmitters will make possible flexible, smooth running programs. It is hoped that the station will be in operation and ready to serve Washington and the surrounding territory within two months.

Everybody's Friend

A proud father recently wrote WGY, the Schenectady broadcasting station of the General Electric Company, requesting the station to announce in the air that an eight pound boy had been born to him and that mother and son "are doing well." Probably every father who recalls his feelings on the arrival of the first born will sympathize with this man whose desire was just a modern elaboration of the wish of a brand new father to shout the good news from the housetops.

This request is unusual but every broadcasting station is asked to make announcements of matters just as personal as this one. It is interesting because it illustrates the intimate, personal relationship which the radio listener feels exists between him and the radio broadcasting station. To the average listener WGY is not an elaborate mechanical outfit consisting of motor-generator set, transmitting equipment and antenna; it is human, its voice comes out of the night and enters his home, amusing the children, entertaining the grown-ups, relieving pain, monotony and loneliness.

It is not to be wondered therefore that those in charge of broadcasting stations receive warm, personal letters from writers unknown to them, or that requests are made to broadcast matters which are purely personal.

A correspondent recently asked WGY to announce that he, his wife and child were all well. He explained that his parents in a western state have a receiving set and frequently hear WGY and he thought it would be fine for them to hear from their son and his family. The writer ingenuously requested that the announcement be made three successive evenings as his parents might be out one or two evenings but would surely get the message one night out of the three.

Another correspondent asked WGY to find his eight-months-old Airedale pup. He said the children missed the puppy and he gave a description of the animal with its license number.

A Cleveland friend of WGY asked the station to co-operate in his plans for a surprise party. The man and wife to be surprised were radio fans and the writer requested WGY to say "Hello Mr. and Mrs. Blank" at the precise time that Mr. and Mrs. Blank's friends would enter the front door.

An unselfish youth requested WGY to repeat the first act of one of its radio dramas because his brother was late getting home and had missed the opening of the play.

Those who make requests for the broadcasting of purely personal matters are informed that the stations are not permitted, under their licenses issued by the United States Department of Commerce, to put anything into the air that might be interpreted as personal or commercial communication.

Radio Exports

American radio exports in January fell off slightly over those of December. The exact figures were: January $141,577 against December, $163,236. During January, the last month for which figures are available, most of these exports went to Canada although large shipments of apparatus went to Australia and Cuba.

California Leads

California still continues to lead in number of broadcasting stations, with fifty-nine in operation, while Texas has climbed to second place with thirty-six. Every state except Mississippi had one or more stations on March 10 when the total of broadcasting stations had reached 588, the highest point since this art was undertaken in September, 1921.

Out of these stations sixty-six represent educational institutions, sixty-seven newspapers and periodicals dispensing information and news as well as entertainment. Several cities, a number of churches, theatres and, of course, many electrical apparatus manufacturers and distributors are also included.

The number of stations in each state follows as of March 10:

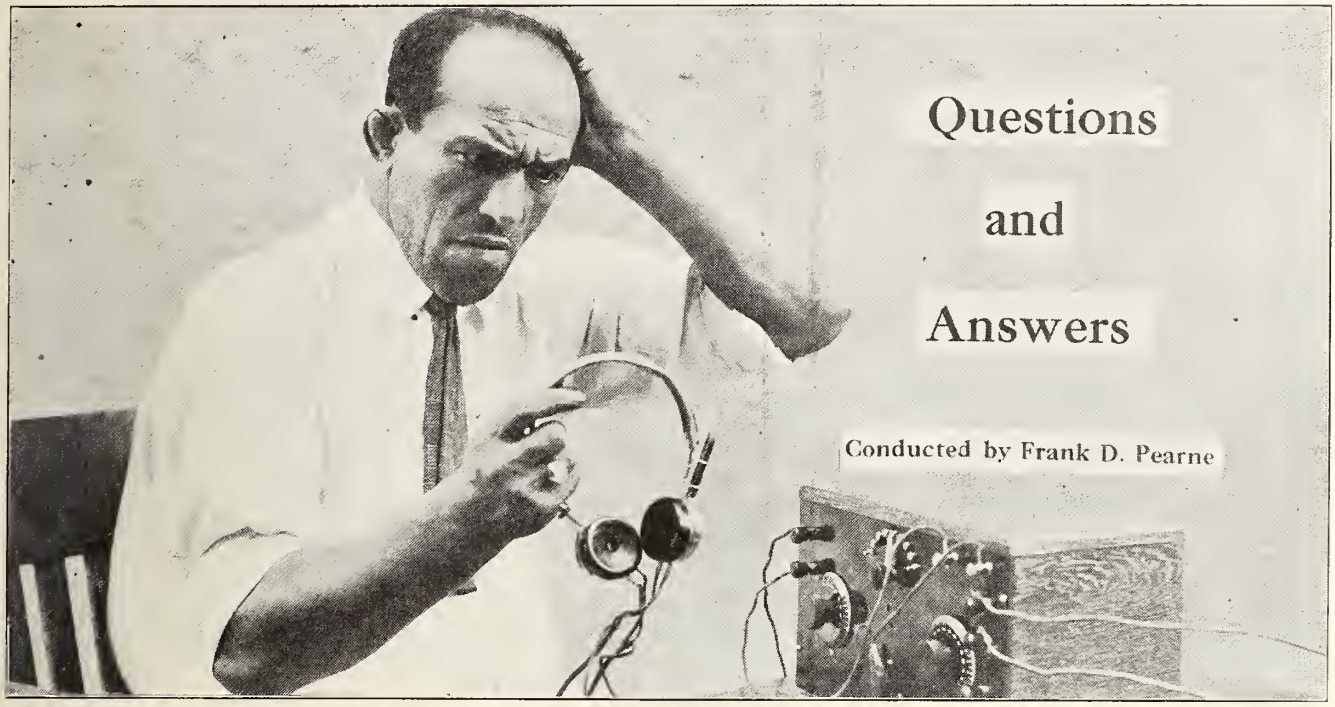
NUMBER OF BROADCASTING STATIONS IN EACH STATE MARCH 10, 1923.

California	59	South Carolina	6
Texas	36	Alabama	5
Ohio	31	Arizona	5
New York	30	Idaho	5
Pennsylvania	28	Maryland	5
Iowa	26	Montana	5
Missouri	25	North Dakota	5
Washington	24	Tennessee	5
Illinois	24	Utah	5
Nebraska	23	Rhode Island	4
Kansas	19	South Dakota	4
Oregon	16	Wyoming	4
Indiana	15	North Carolina	4
Colorado	15	Virginia	4
Michigan	14	Delaware	3
Minnesota	14	Hawaii	3
New Jersey	13	Maine	3
Wisconsin	11	Vermont	3
Florida	11	West Virginia	3
Georgia	10	New Mexico	2
Massachusetts	10	Nevada	2
Dist. of Columbia	9	Porto Rico	2
Oklahoma	8	Alaska	1
Louisiana	8	New Hampshire	1
Connecticut	7	Mississippi	0
Kentucky	7		—
Arkansas	6	Total	588

What WGY Spells

Correspondents of WGY, the General Electric Company radio broadcasting station at Schenectady, N. Y., frequently have trouble in spelling the name of the city. English radio fans generally address "General Electric Company, New York and make no attempt to spell "Schenectady." A five year old boy living at North Hoosick, Mass. has happily solved the problem according to the following which appeared in a Massachusetts newspaper:

Fred Stevens of North Hoosick picked up the five-year-old son of Ira Fisk, and gave the boy a lift on the way to school. The juvenile Fisk is noted for his brightness and Mr. Stevens began a quiz. The youngster, of course, spelled "cat" and things of that kind without any trouble, but Mr. Stevens thought he put a poser when he asked the boy if he could spell "Schenectady." "Sure," was the prompt response, "W GY."



The puzzled gentleman in the above picture is "Bull" Montana, the comedian star of Metro films. For once "Bull" has found something too tough for him.

Fans who are not subscribers may obtain this service by enclosing 50 cents with their question and the reply will be mailed at once, accompanied by circuit diagram where illustration is needed.

All inquiries should be accompanied by self-addressed and stamped envelope.

The technical department sends out many replies to gestionsu in each day's mail. This service heretofore has been free to all but in order to assure this service to our subscribers this direct reply method hereafter must be restricted to those fans who are on our subscription list.

C. F. F., Minden, Nebraska.

Question: I have a Reinartz set and the reception on distance is fine, but it does not seem to have volume enough when anything is brought in. In making the set, I used two model "B" Crosley condensers. Do you think the using of Crosley condensers as above would bring this trouble?

Answer: These condensers should work very well if they have the proper capacity. You do not state whether or not you are using an amplifier. If not, you should do so.

W. H., Jamaica, L. I.

Question: I would like to construct a loose coupler and would be much obliged to you if you would send me a diagram and instructions for winding one.

Answer: We have no stock copies of this particular piece of apparatus, but fortunately I happen to have a copy with working drawings now on hand, which I am mailing to you.

E. H. B. Indianapolis, Ind.

Question: In the December, 1922, issue, you had an article on making a battery charger for $3.00. I have made it exactly as described, purchased pure lead and aluminum plates and ammonium phosphate basic pure at $1.00 per pound. Two and one half pounds was not enough to make a saturate solution, it took four pounds and still it does not work. The lights connected in parallel burn either with or without the positive and negative terminals connected. I am sure I have the right terminals of the lead and aluminum connected as per diagram. Puzzled.

Answer: The lights will burn either with the charging terminals connected or disconnected, on account of a leakage of the valve action, which cannot be prevented, but they should burn much brighter when these terminals are connected, if everything is right. I am under the impression that you did not get the right chemicals, as some users in Chicago only required one pound of phosphate of ammonium, which costs forty cents per pound and are getting very good results. You do not say as to whether you got any results on the direct current terminals.

P. B. St. Louis, Mo.

Question: As I am a subscriber to your magazine, I would like to have you send me a drawing of a large battery tube set, with which I can get California and farther stations. Please send drawing of the one which you think would be the best for an amateur to make.

Answer: There are so many circuits coming out everyday, for which these long distance claims are made, that I hardly know which one to send you. So that I will make no mistake, I am mailing you several, which ought to cover the distance which you want. However, you will find that your location and aerial will have much to do with theresults obtained.

R. N., Omaha, Nebraska.

Question: Would like to hook up three stages of radio frequency to my present Reinartz set, which consists of one stage of radio detector, and one stage of audio. Can you give me this diagram? Also want to use a three coil honeycomb mounting attached, so that I can use honey-comb coils for loading.

Answer: I have drawn a sketch for the circuit described and am mailing it to you. The method of loading the Reinartz circuit is somewhat different from that used on other circuits. I have shown extra contact points in the grid and aerial switches. These are to be connected to the ends of a loading coil, and taps at different points near the center of the coil should be arranged so that a ground connection can be placed on the desired turn. This will be placed on the point giving the best result, as shown.

A. B., Minneapolis, Minn.

Question: I have a Reinartz set with two stages which does not seem to work. I had the set over to two different radio shops and when I got it back and turned on the tubes, all I could hear was noise from the tubes, and the variable condenser did not work. Please send me hook-up of Reinartz set with three jacks.

Answer: As several of our readers have asked for this circuit, I am showing same on this page. Hope it will help you to find the trouble. First of all, make sure that there is no short circuit between the inside and outside coils. This can be determoned by putting a piece of paper under the switch levers, in such a way that the circuit is opened to the contact points. Then test with a buzzer and battery, between the contact points of the switch on the inside coil and those of the aerial coil. If the buzzer does not operate, the coils are O. K. If it does operate, then the coil must be rewound. Next, make sure that the plates of the variable condensers do not touch each other, forming a short circuit. See also that the condenser between the first

coil (inside coil) is connected to the outside end and not the starting end. Also the ground connection to the outside coil must be taken off from the 10th or 11th turn of the second coil, not the starting end.

L. J. L., St. Louis, Mo.

Question: Have noticed several articles in your March issue of Radio Age, of people receiving great distances on Reinartz sets. Would like to know where I could get complete plans for Reinartz, detector unit and two stage amplifier to use with loud speaker. I would also like to know how I can tune out KSD *St. Louis Post Dispatch*, as I am living about three miles from it. I have never built a radio set outside of a double slide crystal set and do not know much about it, but if I can get a hook-up that explains connect ons p'ainly, I am pretty sure I can make one. I have been told that a detector with two stages of amplification will tune out *Post Dispatch*, others have said that it will not, so I am asking your advice.

Answer: You will find it hard to tune out this station, as it is so close that even the finest tuning will not cut it out altogether. The set which you mentioned is as good as most others for close tuning, but the amplification will not help tune them out. You will need this amplification however if you want to use a loud speaker. If you are a subscriber to this magazine look back over the copies of the last few months and you will find all the information necessary to build this set. If not, this office will furnish them at 25c each. The circuit is shown among the questions and answers of this issue.

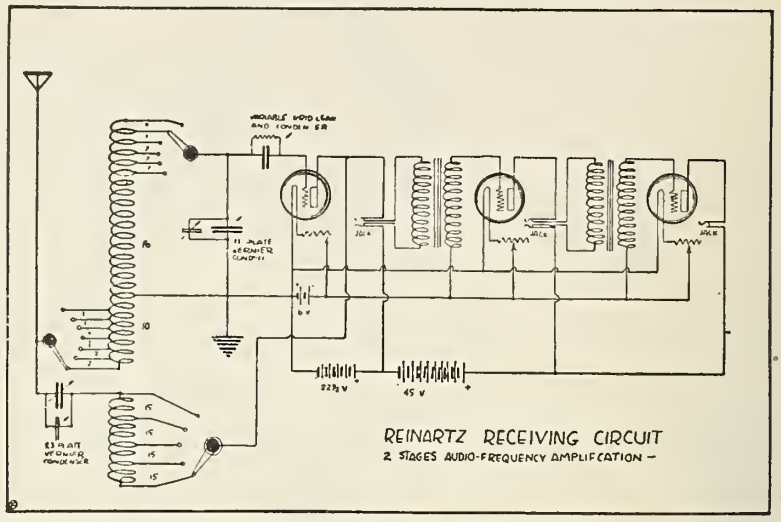
A. P. H., Chicago, Ill.

Question: On the enclosed hook-up, which is the best way to connect up a 43-plate condenser, in the ground lead, across the secondary, or across the primary? My coupler consists of about fifty-four turns on the primary. What is the wave length of this coupler? Would Atwater Kent coupler give better results? I have not been able to get very great distance with this set. Is my coupler at fault?

Answer: Use the condenser either in the aerial or ground circuit. This should help you get a closer adjustment. The winding on your coupler is O. K. for the ordinary broadcasting wave of 360 meters, but as you say nothing about the type and size of aerial used, it is hard to tell just what the result will be. Not knowing the make of your coupler I cannot give any comparison with the Atwater Kent type.

H. G. B., Chicago, Ill.

Question: I am a constant reader of your magazine, "Radio Age" and have found many interesting subjects in it's leaves. I am quite interested in crystal sets and have built a number of them, all of the old fashioned type. I am looking for something more interesting. I read about Mr. Howes' experience and would like very much to try it, hoping you can assist me a little in the parts I do not understand. I have completed the antenna Mr. Howe described and



now I would like to get down to the instrument. This is what I would like to have you show me, so if you will kindly send me some information in regard to the kind of condenser, vario-coupler, and variometer and other parts that I need, also the hook-up, I will be more than thankful to you for your trouble.

Answer: The parts used in this set are all standard and can be purchased at any radio supply store. Any of the standard type of vario-coupler and variometer may be used. All that is necessary is to ask for the parts as listed on the diagram, a copy of which I am mailing to you. I would suggest however, that the .0025 fixed condenser shown in the diagram be used across the phones, and the one marked as .0025 be changed to a .00025 M. F. I do not know of any more information I can give you, as the diagram plainly shows the circuit.

F. H. Davenport, Ia.

Question: I read an article on long distance crystal sets in your March issue of Radio Age. I was unable to get fifty miles with the hook-up I am sending, although it is overly loud at a distance of six miles. Is it possible to make it receive a distance of at least fifty miles or will I need a different set?

Answer: I have never had any experience with the set which you describe, but the circuit looks as though it ought to be good. I would recommend that you build the long distance set described in the January and February issue of this magazine, as this has a very fine tuning arrangement which makes it possible to get in stations which otherwise could not be heard on a crystal set. Many reports from users of this set indicate that it has a record of many hundreds of miles.

F. M. P. Monticello, Ia.

Question: I am a regular reader of the Radio Age and I get much out of it in the way of radio information. Please send me what you consider the very best hook-up you know of, for all around work. Selective, distance, fine tuning, an all around first class outfit.

Answer: I am mailing you several radio frequency circuits which are said to be the extreme limit in perfection. They will require much more apparatus than the ordinary sets, but I know you will be pleased with the results. The one using six tubes has been used here in Chicago, and fifteen outside stations have been tuned in during one hour.

J. A. G. Brooklyn, N. Y.

Question: Will you kindly let me know what is wrong with my crystal set? I have trouble trying to tune out the other fellow, that is, I will get WEAF New York; then WJZ Newark will butt in. If I try to tune out WJZ then WEAF will get very faint. Last night I had three stations on, and I had trouble getting one at a time. I am sending you a diagram of my set. I will appreciate if you will give me some information on this matter, that will bring better results.

Answer: I am afraid you are up against a hard proposition if you want to get these stations separated. They all come in on about the same wave length and with the tuning apparatus which you are using, I don't see how you will be able to tune close enough to cut out the interference, especially so, as all these stations are comparatively close to you. I would advise you to get a copy of the circuit given out some time ago, by the *Evening Mail* and *Home mechanics* of New York. This is a sharp tuning set which might help you.

Good!

An investigation to ascertain whether or not there is a radio trust will soon be launched by the Federal Trade Commission in compliance with the requirements of a House resolution. This resolution directing the Commission to investigate the status of the radio industry to ascertain whether anti-trust statutes were being violated, was received by the Commission recently.

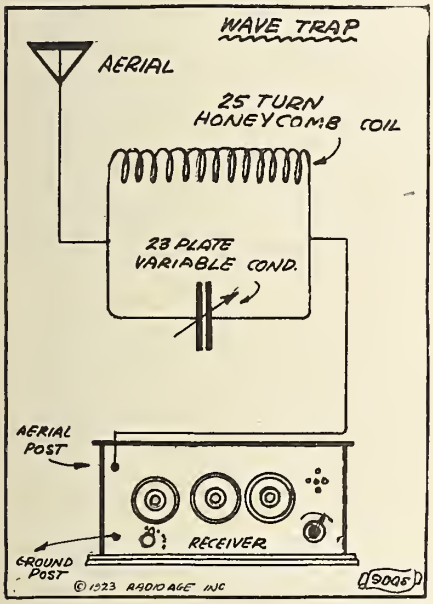
It is understood that a conference of the officials and probably a preliminary investigation will be held before formal action of any sort is taken or witnesses are called. A complete survey of the radio patent field will be undertaken and contracts and agreements will be examined to learn if exclusive rights or special privileges for transmission or reception have been made. No announcement has as yet been made by the Commission.

Little Things That Help

The Wave Trap

THE USE of a wave trap in connection with the receiving set is very often the thing which makes the set a success or failure. It will be found to be of great value, especially on those sets which do not permit sharp tuning.

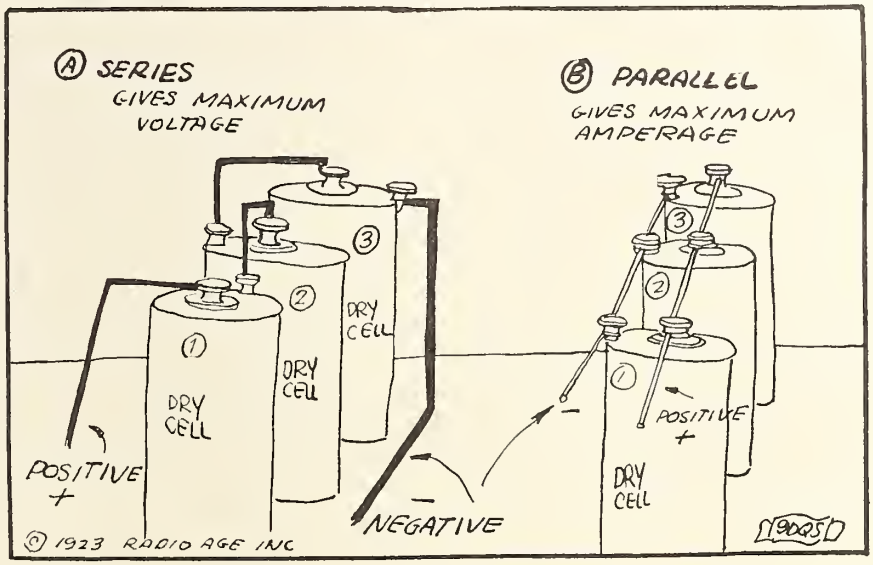
The arrangement of such a trap is shown in the drawing. It consists of a 25 turn honey-comb coil connected in parallel with a variable 23 plate condenser forming an oscillating circuit in itself, which is connected between the serial and the aerial binding post on the set.



The theory of such a combination works on the principle of absorbing the undesired wave in the trap, allowing the wave which is wanted, to pass on to the set without interference. When using the trap, the variable condenser is adjusted until the circuit is oscillating at the same frequency as the undesired wave, which will absorb it in the trap, and upon slightly re-adjusting the tuner, the desired wave will be found to come in just as clearly as before and the interference will have disappeared.

Of course, if the two waves are exactly the same, this arrangement will not work, but usually there is enough difference in the wave lengths of broadcasting and spark stations to make this trap a very important factor in the operation of the set.

Every day brings to light another use for radio broadcasting. It is now revealed that students of shorthand and typewriting are picking up addresses out of the ether to increase their speed at the typewriter or in writing shorthand symbols of the speaker's words. Those who have had to rely upon the patience of a member of the family or a friend to read to them while they dashed down the dots, dashes and curves, can appreciate the advantage of radio dictation.

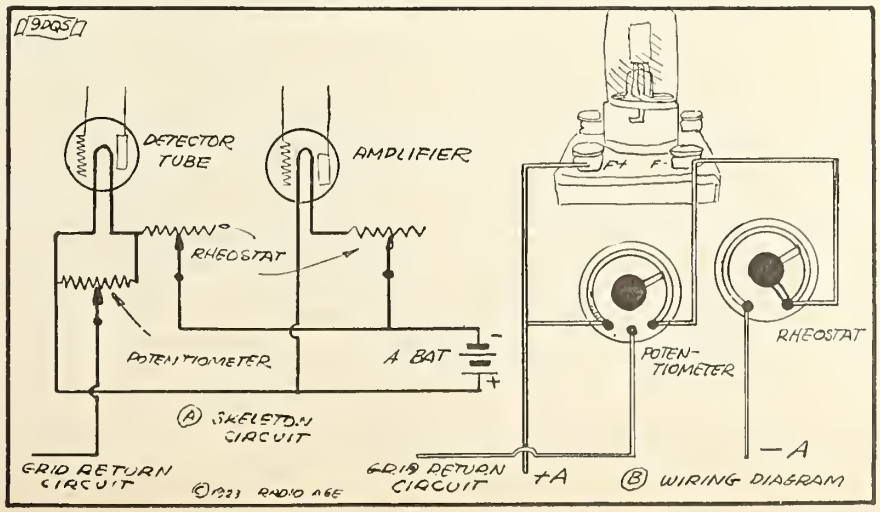


How to Connect Batteries for the Dry Cell Tube

Many of the new dry cell tubes come to a sudden end just because the user does not understand the difference between "series" and "parallel" battery connections. The W-D-11 tube requires one cell of dry battery for proper operation. This dry cell has an electrical pressure of one and one-half volts and will supply the filament current for two or three months before it must be replaced with a new cell. If however, more tubes are added to the set for amplification, the drain on the battery is considerably more. For example, if the set uses three tubes, the life of the cell will be less than one-third of what it would be with one tube. To give the same length of life when more tubes are used, one additional cell should be added for each tube used, but these cells must be connected in PARALLEL, not in series. If connected in series the pressure will be raised 1½ volts for each cell, which would instantly burn out the filament; but if connected in parallel the pressure will remain the same as one cell, but the current strength will cover three times the life of one cell. For use with the new 201-A or 301-A tubes, the three cells will give a pressure of 4½ volts if connected in series. The cut here shown will give an idea of these two methods of connecting.

Connecting the Potentiometer

Many receiving circuits make use of a potentiometer connected across the terminals of the "A" battery. These usually have a very high resistance and the current consumed in this way does not amount to much if the potentiometer is only left in the circuit while the set is in use, but if it is not disconnected by means of a switch, or at the battery



terminals while the set is not in use, then the battery is continually giving up current all the time, whether the set is in use or not, which of course will, in time, drain the battery.

The accompanying drawing shows a method of connecting the potentiometer in such a way, that when the filament rheostat is turned off, the potentiometer is disconnected from the battery. The slight resistance of the rheostat which is also in the circuit, will have no noticeable effect upon the potential of the potentiometer. This arrangement will serve a good purpose, as the operator may feel sure that no current is being wasted when the set is not in use.

Radio Control at Sea

Washington, D. C.—The Iowa, first radio controlled battleship in the world, went to a gallant death last week in the deep reaches of Panama Bay, sunk by gunfire from her younger but more powerful sister, the Mississippi. Her flag was not flying—naval guns are never trained on the flag, though she was still an American vessel designated as Coast Battleship No. 4. She was sacrificed in the interests of radio-control and naval gunnery.

Her loss amounts to nothing, however, compared with the results of the radio-control experiments carried out successfully, and although she carried some valuable and confidential radio control instruments, the radio experts of the navy say no secrets were lost. They had learned all that was possible about controlling the old battleship, so she was turned over to the gunnery and ordinance experts as a mobile target.

Within a short time, another ship could be fitted with radio control, and it is understood that many improvements are planned. Rumor has it that one of the laid-up destroyers will probably soon be assigned for radio control experiments and equipped with highly improved apparatus. But which of these fast scouts of the navy will be used has not been decided. Only the allotment of funds and a month or two of time are needed, it is understood. Radio equipment is ready awaiting assembly and installation.

By equipping a high-speed vessel, capable of making at least twenty knots for radio control, excellent practice could be given the gunners of the navy, it is said. The ship would be controlled from a mother craft by radio and maneuvered while under fire. One new feature planned for the next radio controlled craft is likely to be armor or some protection for her aerials and sensitive radio-receiving and controlling apparatus, since the early hits in the recent one-sided engagement in Panama Bay damaged the Iowa's controls and she ran wild during her death throes. Radio has come to be very valuable, naval experts assert, in gun-fire exercises of this sort, since by virtue of it live targets can be maneuvered for gunnery training—unthought of and impossible, except by towing, until radio made it practical.

186,000 Miles per Second

Words spoken in a public hall in Schenectady reached a radio listener in San Francisco, Calif., 2,550 miles away, before they were heard by a listener 150 feet from the speaker.

That statement looks a bit fantastic but it is mathematically true. The apparent absurdity becomes reasonable when it is realized that the speed of sound is 1,126 feet per second at a temperature of 68 degrees Fahrenheit and the speed of electrical vibrations or radio waves is 186,000 miles per second.

The listener in the back of the hall in Schenectady, 150 feet from the speaker heard the words in 0.1332 seconds.

A microphone connected to the radio transmitting equipment of WGY, the General Electric Company station, was two feet in front of the speaker and picked up the words in 0.002 seconds.

Time required to transform sound waves into electrical energy, 0.002 seconds.

Time required for electrical vibrations or waves to pass from Schenectady to San Francisco, 0.0137 seconds.

Time required at receiving end to convert electrical vibrations into sound vibrations, 0.001 seconds.

Total elapsed time from the speaker in Schenectady to the radio listener in San Francisco, 0.0187.

Listener in hall heard words in 0.1332 seconds.

San Francisco man heard words 0.1145 seconds sooner.

The period of time elapsing between the spoken word and its reception via radio 2,550 miles away can be illustrated as follows: 0.0187 seconds is time required for a spectator at a baseball game to hear the impact of bat against ball when he is standing twenty-one feet from the batter.

In the interests of life saving at sea, based upon "SOS" calls, broadcasting stations are cautioned by the Department of Commerce to maintain a careful watch while sending so that they can cease instantly when a distress call is heard and not interfere with the distress signals and messages relating thereto.

This applies particularly on and near the sea coasts. Recently four vessels issued distress calls near Seattle, Washington on the same day but so far as was reported by Inspectors, no broadcasters interfered. The law provides a penalty in the event of interference with "SOS" calls, as is set forth in Section 4, "Act of August 13, 1912."

An Admiral of the Navy in objecting to the suggested licensing of all service radio operators under commercial regulations, said it would be as sensible to require that he and some 6,000 other navigators in the Navy take the Department of Commerce's examination for a Master's license before they would be permitted to carry any passengers on Naval vessels or transports. Which seems to be a good argument.

President Harding is said to have tried out his radio set for the first time during his recent illness, without satisfactory results. He succeeded in getting a local station and one in Newark at the same time, and, being unable to disentangle what sounded like a conference report, he gave up.

It is understood that radio engineers of the Navy will go over the set and demonstrate its capabilities.

Reinartz Book FREE

Reinartz Radio Book with Hook-ups—best book on best circuit —written and illustrated by Frank D. Pearne. If you want one free sign the coupon below and get the book and one year's subscription to Radio Age for $2.00.

RADIO AGE,
500 North Dearborn St.,
CHICAGO.

Please send me FREE one of your Reinartz Radio Books and send me Radio Age for one year. I want to take advantage of this Special Offer. I enclose $2.00.

Name.....

City.....

Street and Number.....

Pick-Up Records from Our Readers

Radio Age:

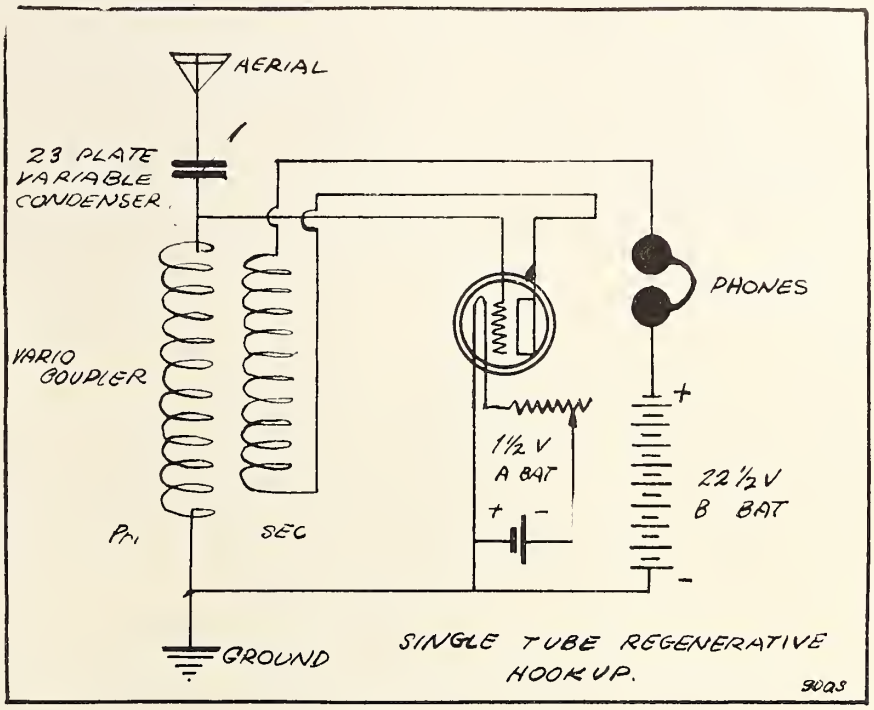
Any amateur of course wants the best set he can get for the money and the best hook up I have just gotten a set like the one I am to describe and used the hook up also that I will draw. This set consists of:

(1) one 23 plate variable condenser.
(2) one grid leak and condenser.
(3) one variocoupler.
(4) Pair of phones.
(5) WD 11 Tube and socket (for dry cell use) dry cell.
(6) one rheostat.
(7) Tapped "B" battery.
(9) Switch lever set.
(11) Phone condenser.
(12) Phone tip jacks (pair).
(13) Dry cell.

With this set and the diagram on next page the first station I caught was WHB which is Sweeny Auto and Tractor School. WOC was the next station to come in real well.

This is the hook up I used;
(See accompanying cut)
This set cost only $20.75 complete.

HAROLD LEE,
Box 309, Fosston, Minn.



G. F. McCullough, 451 Fillmore Street, Minneapolis, Minn., writes:

"Have read several numbers of your magazine and find the same to be very interesting, and note that you have a section of "Stations I have Heard," and believe that I have something that will equal any of the performances noted in that section.

"I am using a Reinartz circuit with only one tube, and on the evening of March 23, I succeeded in getting twelve stations outside the Twin Cities and during this time two local stations were broadcasting, but I tuned these out absolutely, and when I tuned in on one station there was no interference from any of the other stations that were broadcasting at the same time.

"The stations I heard were, WLAG, WAAL, BN7, WOC, KYW, WMC, WCX, KDKA, WMAA, WOS, WGY, WDAF, WBM and KFD. I got each of these stations very clearly and all from 7:30 to 9:00 p. m., when I was interrupted by our station the first mentioned above WLAG, and I must admit that when they start broadcasting that it's all off and we have to listen to them or get off the air."

---

411 West 53rd St.
N. Y. City.

Dear Sir:

Enclosed find some DX work done on a neat home made set costing $35, but using an exceptionally sensitive circuit.

Have heard following: KHJ, WOC, WDAP, KYW, WHB, WWJ, KSD, WHAS, KDKA, WMAE, WGY, WHAZ, WSB, WJZ, WEAF, WOR, WPI, WFI, WOO.

These are only a few of the long distances, as other stations such as Denver, Cincinnati, Cleveland, Springfield, Mass., Havana, San Juan, Porto Rico, etc., have been heard but am not sure of call letters.

All above stations have been heard on detector only night after night and trip after trip during my week stay in Porto Rico. The work which I can do on detector only using present set and circuit were never done by my former regenerative set and two steps.

Sincerely yours,
C. PREVITI,
Chief Operator, S. S. Ponce.

P. S. Above stations were heard both in summer and winter and wish to say that during summer time atmospheric conditions are fierce in the tropics.

Gentlemen:

Herewith check for one year's subscription to Radio Age and a copy of your booklet "Reinartz Radio" as advertised in your April issue.

I have a Reinartz set, home made, and while I have not accomplished wonders, still, I feel that my results compare favorably with some of those published in your paper. Here is a list of stations as well as I can remember and check up from memorandums made at time of reception:

WGM, Atlanta; WSB, Atlanta; WDAJ, College Park; WCX, Detroit; WBAP, Fort Worth; WDAF, Kansas City; WHB, Kansas City; WOC, Davenport; WNAV, Knoxville; KSD, St. Louis; WJAX, Cleveland; PWX, Havana; WBAD, Minneapolis; WHAS, Louisville; WOI, Ames, Iowa; WAAP, Wichita, Kansas; WBAR, Orange, Texas; WDAP, Chicago, Ill.; WFAA, Dallas; WBAY, New York; WKY, Oklahoma City; WWJ, Detroit; WEAF, New York; WGY, Schenectady; WLAG, Minneapolis; WJZ, Newark; KDKA, Pittsburgh; WLK, Indianapolis; WLW, Cincinnati; WGAL, Lancaster, Pa.; WOAI, San Antonio; WOS, Jefferson City; WGF, Des Moines; WPAC, Okmulgee; WHA, Madison, Wis.; WSY, Birmingham; WOAW, Omaha, Neb.; WAAC, New Orleans.

These stations were all picked up since the middle of December. Some of them night after night, others occasionally. In addition to the above on March 10 after 11:30 p. m. I caught the Los Angeles Times and a station in Calgary, Alberta. In addition to these I have caught a number of other stations whose call numbers I could not make out and, therefore, did not log. All were caught without any amplification except on March 10, when I caught Los Angeles and Calgary with one stage of audio amplification.

FRANK A. FLECKENSTEIN,
708 Bethel Street, Memphis, Tenn.

Gentlemen:

I have been taking your Radio Age and will say that it is the best Radio Magazine that I have ever seen.

About a month ago I decided to build a Reinartz set so I started one afternoon and at night I had my machine built with two stage amplification. It sure works fine. I have no trouble in bringing in the volume.

I have picked up several stations, about 70 altogether on the North Calgary CFAC, Regina-CKCK, Winnipeg CJOC, in Canada. On the West, Los Angeles KHJ also KFI. On the South, Galveston WHAB, WBAP, WFAA. On the East, Maine, Auburn WMB, WGY, WHAZ, WFAG, WJZ, also several others.

I see where several persons have made a record of long distance but I have never

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6. How to Make Your Own Parts.
7. Installing the Home Set.

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RADIO AGE, Inc.
500 N. Dearborn St.
CHICAGO ILLINOIS

seen where they have made any long distance by using a loop.

I tried out my Reinartz two stages of amplification with a four loop the other night. I could not get any carry-way at all so I thought I would try my loop, and to my surprise I picked up WBAP, WAAP, WHB, WGY, WCAE, KHJ, and without any aerial or loop I picked up WHB.

I think the Reinartz is the best machine that anybody can build for good reception. Now I don't want you to think that I use a stage or two of radio amplification on this circuit for I did not. You can put this in your magazine if you want to.

C. L. JONES,
Indianola, Nebraska.

Editor, Radio Age:

In your Jan-Feb. issue of Radio Age I see a communication to you from W. G. Lehr of Chicago who uses a Reinartz tuner, stating that it gives excellent results, with two-stages audio frequency amplification. He says he would like to see some vario coupler variometer bugs shoot at his record. Well here goes:

Using home made basketball variocoupler and variometer and one stage of audio frequency amplification I have heard the following stations: KLZ, Denver, Colo.; WLAD, Hastings, Nebr.; WHB, Kansas City, Mo.; WOC, Davenport, Iowa; KSD, St. Louis, Mo.; WSB, Atlanta, Ga.; KYW, Chicago, Ill.; WIAO, Milwaukee, Wis.; WJL, Newark, N. J.; WEAK, St. Joseph, Mo.; PWX, Cuban Tel. Co., Havana, Cuba; WLW, Cincinnati, Ohio; WDAW, Atlanta, Ga.; WWJ, Detroit, Mich.; KOP, Detroit Police Dept.; WLC, New London, Conn.; WLK, Indianapolis, Ind.; WEAN, Providence, R. I.; WEAM, Plainsfield, N. J.; WJAF, Muncie, Ind.; WLAG, Minneapolis, Minn.; WAC, Okmulgee, Okla.; WMAB, Oklahoma City, Okla.

Would call your attention to the fact that our longest distance (to Havana) is about 1500 miles, while 4 other stations exceed his results of 850 miles to Fort Worth.

Bear in mind this also is a home-made set, all inductances being made and wiring being done by myself. Also I am using only (1) one stage of amplification.

Let Mr. Lehr read these and weep.

GERARD A. KOCH,
239 Ella St., Pittsburgh, Pa.

Gentlemen:

Am a reader of Radio Age and particularly of "Pick Up Records by Readers." The following is a partial list of stations we have received since we built our set:

WKKA, KFI, KIZ, KFAF, KSD, KWH, KYW, WOC, WMC, WOR, WMAQ, WBAP, WBAC, WSY, WGM, WSB, WLW, WLAL, WIP, WGR, WGY, WHA, WHAP, WHAZ, WIRO, WDAP, WFAA, WCAE, WBU, WAAP, WPA, WPAC, WMAT, WKY, WLAG, WOH, WAAF, WLK, WMAK, WWJ, WCX, WDAJ, WHAI, WJAN, WLAF, WOS, WRR, WAA, WLAZ, WMAC, WMAP, WHAA, 9XAD, 9XM.

JOHN BOOKER, E. Moline, Ill.

Dear Sir:

I notice in your issue of Jan.-Feb. a letter from one W. G. Lehr, wherein he shouts out a challenge to all variometer "bugs" to equal his wonderful (?) reception record. I don't remember the number of stations he received (magazine was burned by accident), but I do remember it took him nine hours (count 'em) to do it.

Here is the dope on my set: Standard variometer, variocoupler hook-up, using two variometers and two steps of audio frequency amplification. I built the set myself.

Antennae, one wire 75 feet long, twenty feet high on free and five feet high on lead-in end. Ground to waterpipe; no connections in antennae or ground lead soldered.

Copied from log under date March 6, 1923, 7:30 p. m. to 11:40 p. m., WGY, WIAK, WDAF, WFAG, KSD, WCAS, WHB, WCAL, WHA, WLW, WDAP, WSB, WAAW, WCX.

Copied from log under date February 24, 1923, 7:00 p. m. to 11:05 p. m., 9AQC (Voice), WAAW, WIAK, WJAG, WPA, WHB, WHA, KSD, WFAA, WFAV, WMC, KFAF, WOC, KDYS, WLAG, WPAF.

Now, let me say right here, that the Reinartz set is a knock-out when used on two hundred meter reception and I am building one for that especial purpose. But I will wager a dollar to a doughnut that Mr. Lehr hears every two hundred meter spark in thirty miles of him along with his Bedtime Stories. I *never* have any trouble from sparks on my set and darn little from broadcasters.

So hoping I have at least equalled Mr. Lehr's record I will QRX for this time.

Yours truly,
ROSS T. HATTON,
(Radio 9GY), 2220 N. 58 St., Omaha, Nebr.

Dear Sir:

Enclosed find check for $2.50 for Radio Age for one year. I have been reading it regularly and get more real information from it than from most radio publications three times its size.

I wish to thank you for your answers and good letter of the 15th and am sure you should be the most appreciated voice of the radio fans.

My Reinartz record to date, one tube is: KHJ, KFI, KPO, KDKF, 2XI and CJCG on Saturday night. Others are WEAF, WBT, CKCK, KFAF, & CFCA. I am having a little trouble, though, with even loud nearby city stations dying out, and with tuning in desired stations when there is a "gang on the air."

C. M. LEMBERGER,
Burlington, Ia.

Frank F. Howe, 504 Oakland Avenue, Milwaukee, Wis., writes:

"I wish to say that since your Radio Age for the month of March came out containing a write-up of my loop and crystal receptions I have been receiving letters from all parts of the U. S. This shows that you have some circulation. Congratulations."

Corrected List of U. S. Stations Alphabetically by Call Signals

Complete Each Issue

THE list of broadcasting stations on these pages is brought up to date each month by additions of new stations and deletion of those which have suspended operation. The list is the product of a vast volume of correspondence and its completeness is due in large measure to the assistance of our special news service in Washington, D. C. Suggestions, corrections and additional data will be welcomed from readers. Broadcasters: Send in your program schedules.

Important: Wave lengths in this list should be disregarded. Wave lengths under the new rule are apportioned by cities, as explained elsewhere in this issue.

IXAD, Pawtucket, R. I, 300 and 600 meters; 1000 miles; Special license experimental; Standard Radio & Electric Co.
KDKA, E. Pittsburgh, Pa.; Class B station, up to 485 meters; Westinghouse Elec. & Mfg. Co.
KDN, San Francisco, Calif.; Leo J. Meyberg Co.
KDDW, Steamship America, New York.
KDPM, Cleveland, Ohio; Westinghouse Elec. & Mfg. Co.
KDPT, San Diego, Calif.; Southern Elec. Co.
KDYL, Salt Lake City, Utah; news music, entertainment, Telegram Publishing Co.
KDYM, San Diego, Calif.; Savoy Theatre.
KDYQ, Portland, Ore.; Oregon Inst. Technology.
KDYS, Great Falls, Mont.; Class B, 485 meters, Great Falls Tribune.
KDYW, Phoenix, Arizona; Smith Hughes & Co.
KDYX, Honolulu, T. H; 360 wave length; 12:15 to 1:15 p. m., stock reports and weather; 6:30 to 7:30 p. m., music, lectures; Sundays, 11 a. m. to 12:30 p. m., sermon; Honolulu Star-Bulletin, Ltd.
KDZA, Tucson, Ariz.; Arizona Daily Star.
KDZB, Bakersfield, Calif.; Frank E. Seiffert.
KDZE, Seattle, Wash.; Rhodes Co.
KDZF, Los Angeles, Calif.; Automobile Club of Southern California.
KDZG, San Francisco, Calif.; Cyrus Pierce & Co.
KDZH, Fresno, Calif.; Fresno Evening Herald, Class B, 845.
KDZI, Wenatchee, Wash.; Electric Supply Co.
KDZK, Reno, Nev. Wednesday 8 to 9 p m; Friday 8 to 9 p m. Musical and news features; Nevada State Journal, Nevada Machinery & Electric Co.
KDZQ, Denver, Colorado; Pyle & Nichols.
KDZX, San Francisco, Calif.; Glad Tidings Tabernacle.
KDZZ, Everett, Washington; Kinney Bros. & Sipprell.
KFAD, Phoenix, Ariz.; Class B, 485, McArthur Bros. Mercantile Co.
KFAE, Pullman, Wash.; State College of Washington.
KFAF, Denver, Colorado; George S. Walker, Western Radio Corporation; musical programs, news items, etc., daily except Tuesday and Sunday, 8 to 9 p m; mountain standard time.
KFAJ, Boulder, Colo.; University of Colorado.
KFAN, Moscow, Idaho; Electric Shop.
KFAP, Butte, Mont.; Standard Pub. Co.
KFAQ, San Jose, Calif.; City of San Jose.
KFAR, Hollywood, Calif.; Studio Lighting Service Co.
KFAT, Eugene, Ore. Monday, Wednesday and Saturday 8 to 9 p m Music; Sunday 8:30 to 9:15 Church Services; Pacific Radio Co.
KFAU, Boise, Idaho; Class B, 485, Boise High School.
KFAV, Venice, Calif.; Abbott Kinney Co.
KFAW, Santa Anna, Calif.; Class B, 485, Radio Den.
KFAY, Central Point, Ore.; W. J. Virgin Milling Co.
KFAZ, Reddley, Calif., C. H. Weatherll.
KFBB, Havre, Mont.; F. A. Buttrey & Co.
KFBC, San Diego, Calif.; W. K. Azbill.
KFBD, Hanford, Calif.; California Radio Lab.
KFBE, San Louis Obispo, Calif.; R. H. Horn.
KFBG, Tacoma, Wash.; First Presbyterian Church.
KFBH, Marshfield, Ore.; Thomas Musical Co.
KFBK, Sacramento, Calif., 2,000 miles; daily, 3 to 4 p m and 6 to 6:30 p m; Sunday and Thursday 8 to 9 p m; Kimball-Upson Co. and Sacramento Union.
KFBL, Everett, Wash.; Leese Bros.
KFBU, Laramie, Wyo.; N. S. Thomas.
KFCB, Phoenix, Ariz.; Nielson Radio Supply Co.
KFCD, Salem, Ore.; F. S. Barton.
KFCF, Walla Walla, Wash.; Frank A. Moore.
KFCH, Billings, Mont.; Elec. Service Station.
KFCK, Colorado Springs, Colo.; Colorado Springs Radio Co.
KFCL, Los Angeles, Calif.; Los Angeles Union Stock Yards.
KFCM, Richmond, Calif., Richmond Radio Shop.
KFCQ, Casper, Wyo.; Motor Service Station.
KFCP, Ogden, Utah, Ralph W. Piggare.
KFCV, Houston, Tex., Fred Mahaffey, Jr.
KFCY, Le Mars, Ia.; Western Union College.
KFCZ, Omaha, Nebr.; Omaha Central High School.
KFDA, Baker, Ore.; Adler's Music Store.
KFDB, San Francisco, Calif.; Mercantile Trust Co., also 400
KFDD, Boise, Idaho; St. Michael's Cathedral.
KFDD, Bozeman, Mont.; Everett H. Cutting.
KFDP, Des Moines, Ia.; Hawkeye Radio & Supply Co.
KFDS, San Fraocisco, Calif.; John D McKee.
KFDU, Lincoln, Nebr.; Nebraska Radio Electric Co.
KFDV, Fayetteville, Ark.; Gilbrech & Stinson.
KFDY, Brookings, S. D.; South Dakota State College of Agriculture and Mechanical Arts.
KFDL, Denver, Colo.; Knight Campbell Music Co.
KFDJ, Corvallis, Ore.; Oregon Agri. College.
KFDC, Spokane, Wash ; Radio Supply Co.
KFDF, Casper, Wyo.; Wyoming Radio Corp.
KFDR, York, Nebraska; Bullock's Hardware & Sporting Goods.
KFDX, Shreveport, La.; First Baptist Church.
KFDZ, Minneapolis, Minn.; Harry O. Iverson.
KFEB, Taft, Calif.; City of Taft.
KFEC, Portland, Ore.; Meier & Frank Co.
KFEJ, Tacoma, Wash.; Guy Greason.
KFEL, Denver, Colo., Winner Radio Corp.
KFEP, Denver, Colo., Radio Equipment Co.
KFEQ, Oak Nebraska; J. L. Scroggin.
KFEQ, Oak, Nebraska; J. L. Scroggin.
KFER, Fort Dodge, Ia.; Auto Electric Service Co. 1oc.
KFEV, Douglas, Wyo.; Entertainment and weather; Radio Electric Shop
KFEY, Kellogg, Idaho; Bunker Hill & Sullivan Mining & Construction Co.
KFEZ, St. Louis, Mo.; American Society of Mechanical Engineers.
KFFA San Diego, Calif.; Dr. R. C. Shelton.
KFFE, Pendleton, Ore.; Eastern Oregon Radio Co.
KFFD, Hillsboro, Oregon; Dr. E. H. Smith.
KFFP, Moberly, Missouri; First Baptist Church.
KFFQ Colorado Springs, Colo., Marksheffel Motor Co.
KFFR, Sparks, Nev.; Jim Kirk.
KFFV, Lamoni, Iowa; Graceland College.
KFGB, Pueblo, Co., Loewenthal Bro.
KFGF, Mt. Vernon, Wash.; Buchanan, Stevens & Co.
KFGH, Stanford Univ., Calif
KFGL, Arlington, Oregon; Arlington Garage.
KFHA, Gunnison, Colo.; Colorado State Normal School,
KFHB, Hood River, Oregon; P. L. Boardwell.
KFHH, Neah Bay, Wash.; Ambrose McCue,
KFHJ, Santa Barbara, Calif., Fallon Co.
KFHR, Seattle, Wash.; Star Electric & Radio Co.
Paul Franklin Johnson, Altadena Radio Lab.
KFI, Los Angeles, Calif. (485 also); radius covers entire U. S. and Canada; Daily, 6:45 to 11 p. m. Sunday 10 to 11 a. m., 4 to 4:30 and 8 to 11 p. m.; entertainment and educational features; station operates three remote control stations; Earle C. Anthony, Inc.
KFIF, Portland, Ore.; Benson Tech. Student Body.
KFIU, Gridley, Calif.; The Precision Shop.
KFV, Yakima, Wash.; Foster-Bradbury Radio Store.
KFZ, Spokane, Wash.; Doerr-Mitchell Elec. Co.
KGB, Tacoma, Wash., Sunday: 5 to 7:30; Daily: 7 to 9 p. m. (except Thursday) News, Sport bulletins, lectures, entertainment, weather, tide tables, bedtime stories, time, etc.; Tacoma Daily Ledger station operated by the William A. Mullins Electric Co.
KGG, Portland, Ore.; Hallock & Watson Radio Service.
KGN, Portland, Ore.; Northwestern Radio Mfg. Co.
KGD, Altadena, Cal. 2500 miles; every Saturday 8 to 9:30 p m Musical program;
KGU, Honolulu, Hawaii, Waikiki Beach, Marion A. Mulroney; Henolulu Advertiser
KGW, Portland, Ore.; Oregonian Pub. Co., also 400.
KGY, Lacey, Wash.; St Martin's College, (Rev. S. Ruth).
KHJ, Los Angeles, Calif., 400 meters, Daily except Sunday: 12:30 p. m. to 1:15 p. m. news and concerts; 7 to 7:30 p. m. Children's Half Hour; 8 to 9:30 p. m. De Luxe program of music, news and educational features; Sunday: 10 to 11 a. m. Scripture reading, sermon, prayer and sacred musical program; Pacific time; Times-Mirror company.
KHQ, Seattle, Wash.; Louis Wasmer.
KJJ, Sunnyside, Calif.; The Radio Shop.
KJQ, Stockton, Calif.; C. O Gould.
KJS, Los Angeles, Calif.; Bible Inst. of Los Angeles.
KLB, Pasadena, Calif : J. J. Dunn & Co.
KLM, Del Monte, Calif.; Noggle Elec. Works.
KFDH, Tucson, Ariz.; Univ. of Arizona.
KLS, Oakland, Calif.; Warner Bros.
KLX, Oakland, Calif.; Tribune Pub. Co.
KLZ, Denver, Colo.; Class B, 485, Reynolds Radio Co.
KMAZ, Macon, Ga., Mercer University.
KMC, Reedley, Calif.; Lindsay-Wetherill Co.
KMJ, Fresno, Calif. Max. 2576 Miles; Musical program, San Joaquin Light & Power Corp.
KMD, Tacoma, Wash., Love Electric Co.; Tacoma Times.
KNI, Eureka, Calif.; T. W. Smith.
KNJ, Roswell, New Mexico, 360, 485, 1000 miles; Every evening at 8; news, weather reports, stock market, concerts and sermons; Roswell Public Service Co.
KNN, Los Angeles, Calif.; Bullocks.
KNT, Aberdeen, Wash.; North Coast Products Co.
KNV, Los Angeles, Calif.; Radio Supply Co.
KNX Los Angeles, Calif.; Electric Lighting Supply Co.
KDA, Denver, Colo.; Y. M. C. A.
KDB, State College, N Mex. 485 also; time signals and weather reports 12 noon and 10: p m, mountain time; music and lectures Monday, Wednesday and Friday, 7:30 to 8:30 p m; New Mexico College of Agriculture and Mechanical Arts.
KDE, Spokane, Wash.; Spokane Chronicle.
KDP, Detroit, Mich., Detroit Police Dept.
KDQ, Modesto, Calif., Modesto Evening News.
KPD, San Francisco, Calif., Hale Bros.
KQI, Berkeley, Calif., Univ. of California.
KQP, Hood River, Oregon; Apple City Radio Club.
KQV, Pittsburgh, Pa., Doubleday-Hill Elec. Co.
KQW, San Jose, Calif., Chas. D Herrold.
KQY, Portland, Ore; 1,000 miles, Monday, Tuesday, Saturday, 9 to 10 p m; Wednesday, Thursday, Friday, 6 to 7 p m; Stubbs Electric Co.
KRE, Berkeley, Calif., Maxwell Electric Co.
DSC, San Jose, Calif., O. A. Hale & Co.
KSD, St. Louis, Mo.; 1700 miles; 485 meters; grain, livestock, cotton, New York stocks, poultry and butter market, metal market, official weather and news at 9:40, 10:40, 11:40, 12:40, 1:40, 2:40 and 4 p m; 8: p m 400 meters, musical and other features; Pulitzer Publishing Co., St. Louis Post Dispatch.
KSL, San Francisco, Calif., The Emporium.
KSS, Long Beach, Calif., Prest & Dean Radio Research Lab.
KSU, Wenatchee, Wash., 360 and 485.
KTW, Seattle, Wash., First Presbyterian Church.
KUD, San Francisco, Calif., Examiner Printing Co., San Fran. Examiner.
KUS, Los Angeles, Cal. 500 miles; setting up exercises daily, 7 to 7:30 a m and 12:00 noon to 12:30 p m; concert, 65 voices, 6 to 6:45 p m, Wednesdays and Fridays; City Dye Works.
KUY, Del Monte Calif., Coast Radio Co.
KWG, Stockton, Cal. Daily Market reports, music and news 4 to 5 p m; Music, 2 to 3 p m, Sunday; Tuesdays and Fridays, music, 8 to 9 p m. Portable Wireless Telephone Co.
KWH, Los Angeles, Calif., 485 also Los Angeles Examiner.
KXD, Modesto, Calif., Herald Publishing Co.
KYI, Bakersfield, Calif., Alfred Harrell.
KYJ, Los Angeles, Calif., Leo J Meyberg Co.
KYQ Honolulu, T. H., The Electric Shop.
KYW, Chicago, Ill., Westinghouse Elec. & Mfg. Co.
KZC, Seattle, Wash., Public Market & Dept. Store Co.
KZM, Oakland, Calif., Western Radio Inst.; Preston D. Allen.
KZN, Salt Lake City, Utah, The Deseret News.
KZV, Wenatchee, Wash., Wenatchee Battery & Motor Co.
NDF, Anacostia, D. C., 412 only, U. S. Navy Dept.
PWX, Havana, Cuba, Cuban Telephone Co.
WAI, Dayton, Ohio, McCook Field, U. S. Army.
WAAB, New Orleans, La., Valdemar Jensen.
WAAC, New Orleans, La., Tulane Univ.
WAAD, Cincinnati, Ohio, Ohio Mechanics Inst.
WAAF, Chicago, Ill., Chicago Daily Drovers Journal.
WAAE, St. Louis, Mo., St. Louis Chamber of Commerce.
WAAH, St. Paul, Minn.; Commonwealth Electric Co.
WAAJ, Boston, Mass., Eastern Radio Inst.
WAAK, Milwaukee, Wis., Gimbel Bros.
WAAL, Mioneapolis, Minn., Minnesota Trihune Co. & Anderson-Baamish Co.
WAAM, Newark, N. J, 200 miles; musical and code, every week day 11 to 11:55 a m, 3 to 4 p m; Wednesday evenings 8 to 9; I. R. Nelson Company.
WAAN, Columbia, Mo., Univ. of Missouri.
WAAP, Wichita, Kans., United Elec Co.; Otto W. Taylor.
WAAQ, Greenwich, Conn., New England Motor Sales Co.
WAAS, Decatur, Ga., Georgia Radio Co.
WAAT, Jersey City, N. J., Jersey Review.
WAAW, Omaha, Neb., Omaha Grain Exchange.
WAAY, Youngstown, Ohio, Yobrling Rayner Music Co.

(Continued on next page.)

Corrected List of U. S. Stations Alphabetically by Call Signals

WAAZ, Emporia, Kans.; Daylite 100 miles; nite 500-1000 miles; each Tuesday and Thursday from 7 to 8 p m. Acknowledge all communications at 7:15 p m. The Hollister Miller Motor Co.
WAJT, Marshall, Mo., Kelly-Vawter Jewelry Co.
WAJU, Yankton, S. D., Yankton College.
WBAA, W. Lafayette, Ind., Purdue University.
WBAD, Minneapolis, Minn., Sterling Elec. Co. & Journal Printing Co.
WBAE, Peoria, Ill., Bradley Polytechnic Inst.
WBAF, Moorestown, N. J., Fred M. Middleton.
WBAG, Bridgeport, Pa., Diamond State Fibre Co.
WBAH, Minneapolis, Minn., The Dayton Co.
WBAM, New Orleans, La., I. B. Bennyson.
WBAN, Paterson, N. J., Wireless Phone Corp.
WBAO, Decatur, Ill.; 100 miles; occasional music; sermons; James Millikin Univ.
WBAP, Fort Worth Tex. 400-485; 4000 miles; Markets and News; Feature concert Monday to Friday inclusive; 9:30 p m to 10:45 p m, Central Time; Quiet nights Saturday and Sunday. The Star-Telegram.
WBAQ, South Bend, Ind., Myron L. Harmon.
WBAU, Hamilton, Ohio, Republican Publishing Co.
WBAV, Columbus, Ohio, 485, also Erner & Hopkins Co.
WBAW, Marietta, Ohio, Marietta College.
WBAX, Wilkes-Barre, Pa., John H. Stenger, Jr.
WBL, Anthony, Kans., T. & H. Radio Co
WBS, Newark, N. J.; Radius 500 mi.; Musical and Educational, week days: 10:30 to 11 a. m.; 1:00 to 1:15 p. m.; 2:15 to 2:30 p. m.; 7:30 to 8:30 p. m.; Sundays, 9 to 10:30 a m; 1 to 3 p m; D. W. May, Inc.
WBT, Charlotte, N. C. 1200 miles; 11: a m weather report 485; 4:30 p m mechanical music; 8: p m Market Report; 8:30 Tuesday and Friday regular concert; 7:30 p m Sunday, Church Southern Radio Corp.
WBU, Chicago, Ill., City of Chicago.
WBZ, Springfield, Mass., Westinghouse Elec. & Mfg. Co.
WCAB, Newburgh, N. Y., Newburgh Daily News; Newburgh News Printing & Pub. Co.
WCAC, Fort Smith, Ark., John Fink Jewelry Co.
WCAD, Canton, N. Y., St. Lawrence University.
WCAE, Pittsburgh, Pa. 400 meter; 12:30 news and reports; 3:30 weather reports; 4:15 Closing Market reports; 7:30 Late news and lecture; 8:30 musical programs; Kaufmann Baer Co.
WCAG, New Orleans, La., Daily States Pub. Co.
WCAH, Columbus, O. Daily program 11:30 to 12:30; Every Tuesday evening at 7, musical program; C. A. Entrekin Electric Co.
WCAI, San Antonio, Texas, Southern Equipment Co.
WCAJ, Univ. Place, Neb., Nebraska Wesleyan University.
WCAK, Houston, Texas, Alfred P. Daniel.
WCAL, Northfield, Minn., St. Olaf College.
WCAM, Villanova, Pa., Villanova College.
WCAO, Baltimore, Md., Sanders & Stayman Co.
WCAR, San Antonio, Texas, Alamo Radio Elec. Co.
WCAS, Minneapolis, Minn., Wm. H. Dunwoody Industrial Inst.
WCAT, Rapid City, S. Dak., 485 also South Dakota School of Mines.
WCAU, Philadelphia, Pa. 485 also; 1000 miles; Daily 10:30 a m; 2:30 p m; 6:30 p m; regular concert 10 to 12 noon; Tuesdays, Fridays, Saturdays; Durham & Co., Inc.
WCAV, Little Rock, Ark., J. C. Dice Elec. Co.
WCAW, Omaha, Nebr., Woodmen of the World.
WCAX, Burlington, Vermont, University of Vermont.
WCAY, Milwaukee, Wis., Kesselman O'Driscoll Co.
WCE, Minneapolis, Minn., Findley Elec. Co.
WCK, St. Louis, Mo., Stix Baer & Fuller.
WCM, Austin, Texas, Univ. of Texas.
WCN, Worcester, Mass., 485 also Clark University.
WCX, Detroit, Mich., Detroit Free Press.
WDAC, Springfield, Ill., Ill Watch Co.
WDAD, Lindsburg, Kas.; Central Kansas Radio Supply.
WDAE, Tampa, Fla., 485 also Tampa Daily News.
WDAF, Kansas City, Mo., 400 and 485, also Kansas City Star.
WDAG, Amarillo, Texas, K. Laurence Martin.
WDAG. Brownsville, Pa., Hartman-Riker Elec. & Mach.Co.
WDAH, ElPaso, Tex.; Trinity Methodist Church.
WDAI, Syracuse, N. Y., 485 also Hughes Electrical Corp.
WDAJ, College Park, Ga., Atlanta & West Point R. R. Co.
WDAK, Hartford, Conn., Hartford Courant.
WDAL, Jacksonville, Fla., 485 also, Florida Times Union.
WDAD, Dallas, Texas, Automotive Elec. Co.
WDAP, Chicago, Ill., markets, 485; concerts 360; Daily on all business days: 9:30 a. m. receipts and shipments; estimated car lots; local weather report; opening futures market in wheat, corn, oats, rye, barley, pork, lard and ribs. 10 a. m. Future quotations, live stock receipts and prices; 10:30 a. m. futures quotations; 11 and 11:30 a m. same; 12 noon, futures and casb grain prices; 12:30 and 1 p. m. futures quotations; 1:20 p. m. closing futures quotations and high and low for day. Cash grain prices. Gross bids for cash grain to arrive. 6 p. m. closing quotations; news items. On Saturdays closing prices at 12:05 p. m. instead of 1:20 p. m. Visible supply changes sent when posted. Regular concert schedule 10 p. m. Tuesdays, Thursdays and Saturdays. Sunday evenings 9 p. m. and 10 p. m. Chicago Board of Trade official station.
WDAR, Philadelphia, Pa.; Lit Brothers.
WDAS, Worcester, Mass., Samuel A. Waite.
WDAU, New Bedford, Mass., Slocum & Kilburn.
WDAX, Centerville, Iowa, First Nat'l Bank.
WDAY, Fargo, N. D., Kenneth M. Hance.
WDM, Washington, D. C., Church of the Covenant.
WDT, New York, N. Y., Ship Owners Radio Service.
WOZ, Tuscola, Ill., James L. Busb.
WEAA. Flint, Mich., Fallain & Lathrop.
WEAB, Fort Dodge, Iowa, Standard Radio Equip. Co
WEAD, Atwood, Kans., Northwest Kansas Radio Supply Co.
WEAE, Blacksburg, Va., Virginia Polytechnic Inst.
WEAF, New York City, N. Y., Western Electric Co.
WEAG, Edgewood, R. I., Nichols-Hineline-Bassett Lab.
WEAH, Wichita, Kans., Wichita Board of Trade and Lander Radio Co
WEAI, Ithaca, N. Y., Cornell University.
WEAJ, Vermillion, S. Dak., University of South Dakota.
WEAK, St. Joseph, Mo., Julius B. Abercrombie.
WEAM, North Plainfield, N. J., Burough of N. Plainfield
WEAN, Providence, R. I., The Shepard Co.
WEAD, Columbus, Ohio, Ohio State University.
WEAP, Mobile, Ala., 485 also Mobile Radio Co.
WEAQ, Berlin, N. H., Y. M. C. A.
WEAR, Baltimore, Md., Balt. American & News Pub. Co
WEAS, Washington, D. C., The Hecht Co.
WEAT, Tampa, Fla., John J. Fogarty.
WEAU, Sioux City, Iowa, Davidson Bros. Co.
WEAV., Rushville, Nebr., Sheridan Elec. Service Co
WEAX, Little Rock, Ark., T. J. M. Daly.
WEAY, Houston, Texas, Will Horwitz, Jr.
WEAZ, Waterloo, Iowa, Donald Redmond.
WEB, St. Louis, Mo., The Benwood Co., Inc.
WEH, Tulsa, Okla., Midland Refining Co.
WEV, Houston, Texas, 485 also Hurlburt-Still Elec. Co.
WEW, St. Louis, Mo., 485 also St. Louis Univ.
WEW, St. Louis, Mo., 360 and 485; Market and weather reports at 9: a m, 10: a m, 2: p m; no other regular program; St. Louis University.
WEY, Wichita, Kansas, 485 also Cosradio Co.
WFAA. Dallas, Texas, 400 and 485 also A. H. Belo & Co.
WFAW, Miami, Fla., 1500 miles; 7:30 to 9 p. m. concerts including Arthur Pryor's Band evenings and W. J. Bryan Sunday School, Sunday a m; Miami Daily Metropolis & Electrical Equipment Co.
WEAB, Syracuse, N. Y., C. F. Woese.
WFAC, Superior, Wis., Superior Radio Co.
WFAF, Poughkeepsie, N. Y., H. C. Spratley Radio Co.
WFAG, Waterford, N. Y., Radio Engineering Lab.
WFAH, Port Arthur, Texas, Elec. Supply Co.
WFAJ, Asheville, N. C., Hi-Grade Wireless Instrument Co.
WFAK, Brentwood, Mo., Domestic Electric Co.
WFAM, St. Cloud, Minn., 485 also Granite City Elec. Co. and Times Pub. Co
WFAN, Hutchinson, Minn., 485 also Hutchinson Electric Service Co.
WFAQ, Cameron, Mo., Cameron Radio Co. and Mo. Wesleyan College.
WFAT, Sioux Falls, S. Dak. 485; also Argus-Leader.
WFAU, Boston, Mass., Edwin C. Lewis.
WFAV, Lincoln, Nebr., 485 also Univ. of Nebr. Dept. of Elec. Engineering.
WFAY, Independence, Kans., Daniels Radio Supply Co.
WFAZ, Charleston, S. Carolina. S. C. Radio Shop
WFI, Philadelphia, Penn., 400 and 485, also Strawbridge & Clothier.
WGAC, Brooklyn, N. Y., Orpheum Radio Stores Co.
WGAD, Ensenada, Porto Rico, Spanish-American School of Radio-telegraphy.
WGF, Des Moines, Iowa 300 miles; Musical and entertainment Tuesday and Friday 7:30 p m; Church Services Sunday at 5 p m or 7:45 p m as announced; Special programs as announced Register and Tribune.
WGAH, New Haven, Conn., New Haven Elec. Co.
WGAJ, Shenandoah, Iowa, W. H. Gass.
WGAK, Macon, Ga., Macon Elec. Co.
WGAL, Lancaster, Pa., Lancaster Elec. Supply & Construction Co.
WGAM, Orangeburg, S. C., Orangeburg Radio Equip. Co.
WGAN, Pensacola, Fla., Cecil E. Lloyd.
WGAQ, Shreveport, La., Glenwood Radio Corp.
WGAR, Fort Smith, Ark., Southwest American.
WGAT, Lincoln, Nebr., Am. Legion, Dept. of Nebr.
WGAU, Wooster, Ohio, Marcus G. Limb.
WGAV, Savannah, Ga., B-H Radio Co.
WGAW, Aitoona, Pa., Ernest C. Albright.
WGAX, Washington Court House, Ohio, Ohio Radio Elec. Co.
WGAY, Madison, Wis., North Western Radio Co.
WGAZ, South Bend, Ind., Soutb Bend Tribune.
WGI, Medford Hillside, Mass., 485, also Am. Radio & Research Corp
WGL, Philadelphia, Pa., Thos. F. J. Howlett.
WGM, Atlanta, Ga., 400 only, Atlanta Constitution.
WGR, Buffalo, N. Y., 485 also Federal Tel. & Teleg. Co.
WGV., New Orleans, La., Interstate Elec. Co. 485 also.
WGY, Schenectady, N. Y., 400 and 485 also General Elec. Co.
WHA, Madison, Wis., 485 also Univ. of Wis.
WHAA, Iowa City, Ia; 500 miles; 8:30 p m, Monday, Instruction; Tuesday, concert Wednesday, popular lecture; Friday, University News; public lectures and concerts irregularly; State University of Iowa.
WHAB, Galveston, Texas, 300, 485, 600 also Clark W. Thompson (Fellman's Dry Goods Co.)
WHAC, Waterloo, Iowa, Cole Bros. Elec. Co.
WHAD, Milwaukee, Wis., 485 also; Marquette Univ.
WHAE, Sioux City, Iowa, Automotive Elec. Service Co.
WHAG. Cincinnati, Ohio, Univ. of Cincinnati.
WHAH, Joplin, Mo; radius, 1384 mi.;Concerts, markets, weather, etc. Tuesday and Thursday evenings: 8 to 10; Daily except Sundays; 10 a. m. to 2 p. m.; Saturday night special: 11 to 12:30; Hafer Supply Co.
WHAI, Davenport, Iowa, Radio Equip. & Mfg. Co.
WHAJ, Bluefield, W. Va., Bluefield Daily Telegraph and E. K. Kitts.
WHAK, Clarksburg, W. Va., Roberts Hdwe. Co.
WHAL, Lansing, Mich., Lansing Capitol News.
WHAM, Rochester, N. Y. 485 also; Daily—Weather report 2:40 p m; Organ 2:45, 5:00, 6:45; Orchestra 3:00, 7:00; Bed-time stories, Sport results, Business reports and market reports, the latter on 485 meters, 7:15 p m; Sunday—Radio Chapel Service, 3:15 p m; University of Rochester.
WHAO, Savannah, Ga., Frederick A. Hill; every evening 8 to 9; Saturday nights, 12:30 1:30 a. m.
WHAP, Decatur, Ill., Dewey L. Otta.
WHAQ, Washington, D. C., Semmes Motor Co.
WHAR, Atlantic City, N. J., Paramount Radio & Elec. Co.
WHAS, Louisville, Ky., Courier Journal and Louisville Times Co.
WHAV, Wilmington, Del., Wilmington Elec. Spec. Co.
WHAW, Tampa, Fla. 100 miles; 12 to 1, 4 to 5 p m, music; Pierce Electric Co.
WHX, Des Moines, Iowa; 300 miles; 5:45 p m to 6:15 p m Daily; 8:00 p m to 10 p m Wednesday evenings; Central Standard time; Iowa Radio Corp.
WHAY, Huntington, Ind., Huntington Press.
WHAZ, Troy, N. Y., 400 only, Rensselaer Polytechnic Inst.
WHB, Kansas City, Mo., 400 and 485 also Sweeney Auto & Tractor School
WHD, Morgantown, W. Va., W. Va. University.
WHK, Cleveland, Ohio, Warren R. Cox.
WHN, Ridgewood, N. Y., Times Printing & Pub. Co.
WHU, Toledo, Ohio, Wm. B. Duck Co.
WIAB, Rockford, Ill., Joslyn Automobile Co.
WIAC, Galveston, Texas, 485 also Galveston Tribune.
WIAD, Ocean City, N. J., Ocean City Yacht Club.
WIAE, Vinton, Iowa, Mrs. Robt. E. Zimmerman.
WIAF, New Orleans, La., Gustave A. De Cortin.
WJAG, Norfolk, Nebr: 485 also; 200 miles News and Markets 12:15, 3:30 and 5:30 p m. The Huse Publishing Co. The Norfolk Daily News.
WIAH, Newton. Iowa, Continental Radio & Mfg. Co.
WIAI, Springfield, Mo., Heer Stores Co.
WIAJ, Neenah. Wis., Fox River Valley Radio Supply Co.
WIAK, Omaha, Nebr.; 485, 7:45 a m Livestock receipts; 9:10 a m Livestock receipts and opening on hogs; 10:15 a m rainfall and temperature report and weather forecast for Nebraska and Iowa, Livestock market; 12 m cattle, hog and sbsep market; 1:50 p m rainfall and temperature report and weather forecast for Nebraska and Iowa; market detail; 3:50 p m complete market reports and estimated receipts for next day; Daily Journal-Stockman.
WIAO, Milwaukee, Wis., School of Engineering.
WIAP, Springfield, Mass., Radio Development Corp.
WIAQ, Marion, Ind., Chronicle Pub. Co.
WIAR, Paducah, Ky., Musical 3:30 to 4 p. m. and 7 to 8 p. m. except Sundays Paducah Evening Sun; Albert Bennett, operator.
WIAS, Burlington, Iowa, Hawk-Eye Home Elec. Co.
WIAT, Tarkio, Mo., Leon T. Noel.
WIAU, Le Mars, Iowa, Am. Trust & Savings Bank.
WIAV, Binghamton, N. Y., N. Y. Radio Lab.
WIAW, Saginaw, Mich., Saginaw Radio & Elec. Co.
WIAY, Washington, D. C., Woodword & Lothrop.
WIAZ, Miami, Fla., Elec. Supply Sales Co.
WIK, McKeesport, Pa., K. & L. Elec. Shop.
WIL, Washington, D. C., Continental Elec. Supply Co.
WIP, Philadelphia, Pa., Gimbel Bros.
WIZ, Cincinnati, Ohio, 485 also Cino Radio Mfg. Co.
WJAB, Lincoln, Nebr., American Radio Co.
WJAD, Waco, Texas, 485 also Jackson's Radio Engrng. Lab.
WJAF, Muncie, Ind; 1800 miles; 7:30 to 8 Monday, Wednesday, Friday evening, music; 6:30 to 7 p m Saturday, music; 3:30 to 4 every afternoon, News; 10:30 to 12 M Sundays, Church service. Smith Electric-Muncie Press.
WJAJ, Dayton, Ohio 200 miles; Sunday 8:40, 9:15 Religious; Wednesday 9:15, 9:45 Entertainment; Friday 9:15 to 9:45 Entertainment. Y. M. C. A.
WJAK, Stockdale, Ohio, 485 also White Radio Lab.
WJAM, Cedar Rapids, Iowa, Evening Gazette.
WJAN, Peoria, Ill.; Daily Except Sunday: 9 a. m, Peoria Livestock; 9:15 a. m. special weather information; 11:30 a. m. weather, opening livestock and market quotations; 1:30 p. m. closing livestock and markets, official weather information; talk to women by Phyllis Ann; Mondays and Thursdays, government agriograms; 5:30 p. m. baseball reports during season; Tuesdays, Thursdays and Saturdays, 9:15 p. m., special concerts as announced; one musical number precedes each broadcasting; Peoria Evening Star.
WJAP, Duluth, Minn. 1500 miles; Sunday 11 a m, 12:30 p m Church Service and organ recital; First Methodist Church, Rev. Chas. N. Pace, Pastor. Monday 8: p m to 9 p m, musical; Thursday 8 p m to 9 p m, musical; Kelley Duluth Co.
WJAQ, Topeka, Kans., Capper Publications.
WJAR. Providence, R. I., The Outlet Co., J. Samuels & Bros.
WJAS, Pittsburgh, Pa., Pittsburgh Radio Supply House.
WJAT, Marshall, Mo., Kelley-Vawter Jewelry Co.
WJAX, Cleveland, Ohio, 485 also Union Trust Co.
WJAZ, Chicago, Ill., Chicago Radio Lab.
WJD, Granville, O; 100 miles, music by Denison Conservatory, educational lectures and discussions; Denison University.
WJH. Washington, D. C., White & Boyer Co.

(Continued on next page.)

Corrected List of U.S. Stations Alphabetically by Call Signals

WJX, New York, N. Y., De Forest Radio Telephone & Teleg. Co.
WJZ, Newark, N. J., 485 also Westinghouse Elec. & Mfg. Co.
WKAA, Cedar Rapids, Ia. (485 also); Daily: weather reports, crop reports, government reports; Mondays, Thursdays and Saturdays: music; H. F. Paar.
WKAC, Lincoln, Neb., Star Pub. Co.
WKAF, Wichita Falls, Texas, W. S. Radio Supply Co.
WKAH, West Palm Beach, Fla., Planet Radio Co.
WKAK, Okemah, Okla., Okfuskee County News.
WKAL, Orange, Texas, Gray & Gray.
WKAN, Montgomery, Ala., Alabama Radio Mfg. Co.
WKAP, Cranston, R. I., Dutee W. Flint.
WKAQ, San Juan, Porto Rico, Radio Corp. of Porto Rico.
WKAR, East Lansing, Mich., Mich. Agri. College.
WKAS, Springfield, Mo., L. E. Lines Music Co.
WKAV, Laconia, N. H., Laconia Radio Club.
WKAW, Beloit, Wisc., Turner Cycle Co.
WKAX, Bridgeport, Conn., Wm. A. MacFarlane.
WKAY, Gainesville, Ga., Brenau College.
WKC, Baltimore, Md., Jos. M. Zamoiski Co.
WKN, Memphis, Tenn., Riechman-Crosby Co.
WKY, Oklahoma City, Okla., 485 also Oklahoma Radio Shop.
WLZ, Fairfield, Ohio, U. S. Army.
WLAC, Raleigh, N. C., N. C. State College.
WLAG, Minneapolis, Minn., Cutting & Walsh Radio Corp.
WLAH, Syracuse, N. Y., Samuel Woodworth.
WLAJ, Waco, Texas, 485 also Waco Elec. Supply Co.
WLAK, Bellows Falls, Vt., Vermont Farm Machine Co.
WLAL, Tulsa, Okla., Tulsa Radio Co.
WLAN, Houlton, Me., Putnam Hdwe. Co.
WLAP, Louisville, Ky., W. V. Jordan.
WLAQ, Kalamazoo, Mich., A. E. Schilling.
WLAS, Hutchinson, Kans., Hutchinson Grain Radio Co.
WLAT, Burlington, Iowa, Radio Specialty Co.
WLAV, Pensacola, Fla.; daily musical program, 8 to 9 p m; The Electric Shop.
WLAW, New York, N. Y., New York Police Dept.
WLAX, Greencastle, Ind., Greencastle Community Broadcasting Station.
WLAY, Fairbanks, Alaska, Northern Commercial Co.
WLAZ, Warren, Ohio, Hutton & Jones Elec. Co.
WLB, Minneapolis, Minn., Univ. of Minn.
WLK, Indianapolis, Ind., 485 also Hamilton Mfg. Co.
WLW, Cincinnati, Ohio, 485 also Crosley Mfg. Co.
WMA, Anderson, Ind., Arrow Radio Lab.
WMAB, Oklahoma City, Okla., Radio Supply Co.
WMAC, Cozenovia, N. Y, 750 miles; music 11: p m; Cleve B. Meredith.
WMAD, Rockport, Mo., Atchinson County Mail.
WMAE, Dartmoutb, Mass., Round Hills Radio Corp.
WMAG, Liberal, Kans., Tucker Elec. Co.
WMAH, Lincoln, Nebr., General Supply Co.
WMAJ, Kansas City, Mo., 485 also Drovers Telegram.
WMAK, Lockport, N. Y., Norton Labs.
WMAL, Trenton, N. J, 100 miles; 7:30 to 9 p m, Mondays and Thursdays, musical programs, lectures etc; Trenton Hardware Co.
WMAM, Beaumont, Texas, Beaumont Radio Equip, Co.
WMAN, Columbus, Ohio, First Baptist Church.
WMAP, Easton, Pa., Utility Battery Service.
WMAQ, Fair Store Building, Chicago; 4:35 to 5 p m, daily; 7 to 7:30 p m, Monday, Wednesday, Friday and Saturday; 7 to 8 p m, Tuesday and Thursday; 9:15 to 10 p m daily; Chicago Daily News and Fair Department Store.
WMAR, Waterloo, Iowa, Waterloo Elec. Supply Co.
WMAT, Duluth, Minn., Paramount Radio Corp.
WMAV, Auburn, Ala., Polytechnic Inst.
WMAW, Wahpeton, N. D., Wahpeton Elec. Co.
WMAX, Ann Arbor, Mich., K. & K. Radio Supply Co.
WMAY, St. Louis, Mo., 600 miles; Religious services Sunday, 11 a m and 8 p m; Tuesday at 7 p m; Kingshighway Presbyterian Church.
WMAZ, Macon, Ga., Mercer University.
WMH, Cincinnati, Ohio, 485 also Precision Equipment Co.
WMU, Washington, D. C., Doubleday-Hill Electric Co.
WNAB, Bowling Green, Ky., Park City Daily News.
WNAC, Boston, Mass.; Monday 4 to 5 p. m. (silent at night) Tuesday 4 to 5 p. m. and 7 to 8:30 p. m. Wednesday 4 to 5 p. m. 9:30 to 11 p. m. Thursday 4 to 5 and 7 to 8:30 p. m. Friday 4 to 5 and 8 to 9:30 p. m. Saturday 4 to 5 and 9:30 to 11 p. m. The Shepard Stores; J. J. Fanning, announcer; Samuel Curtis, operator.
WNAD, Norman, Okla., Okla. Radio Engineering Co.
WNAH, Manhattan, Kans., Manhattan Radio Supply Co.
WNAL, Omaha, Nebr., R. J. Rockwell.
WNAN, Syracuse, N. Y., Syracuse Radio Telephone Co.
WNAP, Springfield, Ohio, Wittenberg College.
WNAQ, Charleston, S. C., Charleston Radio Elec. Co.
WNAS, Austin, Texas, Radio Corp.
WNAT, Philadelphia, Pa. 1000 miles; Talks, Radio information, music, Chapel Service. Wednesday 7:30 p m; Saturday 7:30 p m; Sunday 2:30 and 4:30; Every day 12:15, 1 p m. Lennig Bros. Co.
WNAV, Knoxville, Tenn., People's Tel. and Tel. Co.
WNAY, Baltimore, Md., Shipowners' Radio Service.
WNAX, Yankton, S. D., Dakota Radio Apparatus Co.
WNAW, Fortress Monroe, Va., Henry Kunzman.
WNJ, Albany, N. Y., Shotton Radio Mfg. Co., Inc.
WNO, Jersey City, N. J., Wireless Telephone Co. of Hudson Co., N. J
WOAA, Ardmore, Okla.; radius 1,500 miles; Tuesdays and Fridays: musical and educational programs; Dr. Walter Hardy; station operated by G. H. Reitz.
WOAC, Lima, Ohio, Maus Radio Co.
WOAE, Fremont, Nebr., Medland College.
WOAF, Tyler, Texas, Tyler Commercial College.
WOAH, Charleston, S. C., Palmetto Radio Corp.
WOAI, San Antonio, Tex. 485 also; daily except Sunday 10:30, 12:15, 3, 6 p m, News, market, weather reports; Wednesday, Concert 7:30 to 8:30 p m; Sunday evening concert 9:30 to 10:30 p m; Southern Equipment Co. and The Evening News and The Express.
WOAJ, Parsons, Kans., Erving's Electrical Co.
WOAK, Frankfort, Ky., Collins Hardware Co.
WOAL, Webster Grores, Mo., Wm. E. Woods.
WOAN, Lawrenceburg, Tenn., James D. Vaughan.
WOAQ, Omaha, Nebr. 100 miles; Woodmen of the World.
WOAQ, Portsmouth, Virginia; Portsmouth Kiwanis Club.
WOAR, Kenosha, Wis., Henry P. Lundskow.
WOAS, Middleton, Conn., Bailey's Radio Shop.
WOAT, Wilmington, Del., Boyd Martell Hamp.
WOAU, Evansville, Ind., Sowder Boiling Piano Co.
WOAV, Erie, Pa., Pa. Nat'l Guard.
WOAX, Trenton, N. J., Franklin J. Wolff.
WOAW, Omaha, Neb., 100 miles, Woodmen of the World.
WOAZ, Stanford, Texas, Perick Hughes Co.
WOC, Davenport, Ia, 485 meters; time signals, 10:55 a m; weather 11 a m; 360 meters, 11:05 opening market quotations, agriograms; 12:00 noon, chimes concert; 2:00 p m, closing stocks and markets; 3:30 p m, educational talk; 5:45 p m chimes concert; 6:35, sandman's visit; 7:00 musical program; 8 p m, lecture; Sundays, religious and musical and religious features, 9 a m to 10 p m; Palmer's School of Chiropractic.
WOI, Ames, Ia., 485 also Iowa State College.
WOK, Pine Bluff, Ark., concerts Tuesday and Friday evenings beginning at 9; Sundays, song service and sermons from churches at 11 a. m. and 7:30 p. m., Arkansas Light & Power Co.
WOO, Philadelphia, Pa., 400 and 485 also, John Wanamaker.
WOQ, Kansas City, Mo., 485 also Western Radio Co.
WOR, Newark, N. J., 400 only, L. Bamberger & Co.
WOS, Jefferson City, Mo. 485 also; first fifteen minutes of every hour from 8: a m to 2: p m; 5 p m, marketa and music, 360 meters; Monday, Wednesday, Friday nights, 8 to 9:30 concerts; no Sunday program; Missouri State Marketing Bureau.
WOV, Omaha, Nebr., R. B. Howell.
WOU, Omaha, Nebr., Metropolitan Utilities.
WOZ, Richmond, Ind., 485 also Palladium Printing Co.
WPA, Fort Worth, Texas, 485 also Fort Wortb Record.
WPAA, Waboo, Neb., Anderson & Webster Elec. Co.
WPAB, State College, Pa.
WPAC, Okmulgee, Okla., Donaldson Radio Co.
WPAD, Chicago, Ill., Wieboldt & Co.
WPAF, Council Bluffs, Iowa, Peterson'a Radio Co.
WPAG, Independence, Mo., Central Radio Co.
WPAH, Waupaca, Wis., Wisconsin Dept. of Markets.
WPAJ, New Haven, Conn., Doolittle Radio Corp.
WPAK, Fargo, N. D., North Dakota Agricultural College.
WPAL, Columbus, Obio, Superior Radio & Tel. Equip. Co.
WPAM, Topeka, Kans., Awerbach & Guettel.
WPAP, Winchester, Ky., Theo. D. Phillips.
WPAQ, Frostburg, Md., General Sales & Eng. Co.
WPAQ, Wilmington, Del., Radio Installation Co., Inc.
WPAH, Beloit, Kans., R. A. Ward.
WPAS, Amsterdam, N. Y., J. & M. Electric Co.
WPAT, El Paso, Texas, St. Patrick'a Cathedral.
WPAU, Moorhead, Minn., Concordia College.
WPAV, Laurium, Mich., Paul Tinetti & Sons.
WPAX, Thomasville, Ga., S. W. Radio Co., J. R. Shumate, Jr.
WPAY, Bangor, Me., Bangor Radio Laboratory.
WPAZ, Charleston, W. Va., Dr. John R. Kocb.
WPE, Independence, Mo.
WPG, New Lebanon, Ohio 1500 miles; Program exclusive for the farmer; 12 to 12:15 p m News Flashes; 6 to 6:30 p m, News, Markets; 8 to 9:45 Monday and Wednesday; music and farm program. Nushawg Poultry Farm.
WPI, Clearfield, Pa., Elec. Supply Co.
WPM, Washington, D. C., Thos. J. Williams, Inc.
WPO, Memphis, Tenn., United Equip. Co.
WSAC, Clemson College, S. C.; Clemson Agriculture College.
WQAA, Parkersburg, Pa. 1500 miles, 10:30 p m every evening. Horace A. Beale, Jr.
WQAB, Springfield, Mo., Southwest Missouri State Teachers' College.
WQAC, Amarillo, Texas, E. B. Gish.
WQAD, Waterbury, Conn., Whitall Electric Co.
WQAE, Springfield, Vt., Moore Radio News Station.
WQAF, Sandusky, Ohio, Sandusky Register.
WQAH, Lexington, Ky., Brock-Anderson Elect. Eng Co.
WQAJ, Ann Arbor, Mich., Ann Arbor Times-News.
WQAK, Dubuque, Iowa, Appel-Higley Elec. Co.
WQAL, Mattoon, Ill., Cole County Tel. and Tel. Co.
WQAM, Miami, Fla., Electrical Equipment Co.
WQAU, New York, N. Y., Calvary Baptist Church.
WQAP, Lincoln, Nebr., Am. Radio Co.
WQAQ, Abilene, Texas, West Texas Radio Co.
WQAR, Muncie, Ind., Press Publishing Co.
WQAS, Lowell, Mass.; Prince-Walter Company.
WQAT, Westhampton, Va.; Radio Equipment Corp.
WQAV, Greenville, S. C.; Huntington & Guerry, Inc.
WQAW, Scranton, Pa., Scranton Times.
WQAW, Washington, D. C.; Catholic University.
WQAX, Peoria, Ill.; Radio Equipment Co.
WQAY, Hastings, Nebr., Gaston Music & Furniture Co.
WQAZ, Greensboro, North Carolina; Greensboro Daily News.
WQA, Chicago, Ill., Riverview Park, Walter A. Kuehl.
WRAA, Houston, Texas, Rice Institute.
WRAB, Savannah, Ga.; Savannah Board of Public Education.
WRAC, Mayville, N. D., State Normal School.
WRAD, Marion, Kansas. Taylor Radio Shop.
WRAH, Providence, R. I.; Stanley N. Read.
WRAK, Escanaba, Mich.; Economy Light Co.
WRAL, St. Croix Falls, Wis.; Northern States Power Co.
WRAM, Carthage, Ill., Robert E. Compton & Carthage College.
WRAM, Galesburg, Ill., Lombard College.
WRAN, Waterloo, Iowa, Black Hawk Elec. Co.
WRAO, St. Louis, Mo., Radio Service Co.
WRAP, Winter Park, Fla.; Winter Park Electric Construction Co.
WRAS, McLeansboro, Ill.; Radio Supply Co.
WRAU, Amarillo, Texas, Daily News.
WRAV, Yellow Springs, O., Antioch College.
WRAY Scranton, Pa.; 360 and 485 mi.; radius 400 mi.; Sunday Chapel service; Wednesday: Selective Musical program, 8:15 to 10; Saturday: 8:15 to 11; Radio Sales Corp.
WRK, Hamilton, Ohio, Doron Bros. Elec. Co.
WRL, Schenectady, N. Y., Union College.
WRM, Urbana, Ill., Univ. of Ill.
WRP, Camden, N. J., Federal Inst. of Radio Telg.
WRR, Dallas, Texas, 485 also City of Dallas, Police and Fire Signal Dept.
WRW, Tarrytown, N. Y., Koenig Bros., Tarrytown Radio Research Lab.
WSAA, Marietta, O., B. S. Sprague Electric Co.
WSAB, Cape Girardeau, Mo., Southeast Mo. State College.
WSAC, Clemson College, S. C.; Clemson Agricultural College.
WSAH, Chicago, Ill.; A. G. Leonard, Jr.
WSAJ, Grove City, Pa., Grove City College.
WSAL, Brookville, Ind.; Franklin Electric Co.
WSAP, New York City; Seventh Day Adventist Church.
WSAS, Lincoln, Nebr., State of Nebr.
WSAT, Plainview, Texas, The Plainview Electric Co.
WSAV, Houston, Texas, C. W. Vick Radio Const'n Co.
WSB, Atlanta, Ga., 400 and 485 Atlanta Journal.
WSL, Utica, N. Y., J. & M. Elec. Co.
WSY, Birmingham, Ala., Alabama Power Co.
WTAC, Johnstown, Pa., Penn. Traffic Co.
WTAS, Elgin, Ill.; George D. Carpenter.
WTAU, Tecumseh, Neb., Ruegy Battery & Elec. Co.
WTAW, College Station, Texas, Agricultural and Mechanical College of Texas.
WTG, Manhattan, Texas, Kans. State Agri. College.
WTP, Bay City, Mich., Ra-Do Corp.
WVP, New York, N. Y. Signal Corps, U. S. Army.
WWAC, Waco, Tex; 3000 miles; Weather forecasts 11 a m daily; musical concerts, daily, 1:30 p m and on Wednesday and Saturday evenings at 8; Sanger Bros.
WWAD, Philadelphia, Pa., Wright & Wright, Inc.
WWAJ, Columbus, O.; Columbus Radio Club.
WWAX, Laredo, Texas, Worman Bros.
WWAY, Chicago, Ill.; Marigold Gardens.
WWB, Canton, Ohio, Daily News Printing Co.
WWI, Dearborn, Mich., Ford Motor Co.
WWJ, Detroit, Mich., 400 485, Evening News.
WWL, New Orleans, La.; Musical and Educational; Loyola University; operated by Dept. of Physics.
WWX, Washington, D. C., Post Office Dept.
2XAI, Newark, N. J., Westinghouse Elec. & Mfg. Co.
2XI, New York City, A. T. & T. Co.
2XJ, Deal Beach, N. J., Amer. Tel. & Telg. Co.
3XW, Parkersburg, Pa., Horace A. Beale, Jr.
3YN, Washington, D. C., Nat'l Radio Inst.
9ARU, Louisville, Ky., Darrell A. Downard.

Deaf Pupils "Hear" Music by Radio

PUPILS and instructors at the State School for the Deaf were enthusiastic today over the fact that deaf children heard by radio in an experiment conducted by The Times at the school last night.

A score of children, some of them rated entirely deaf and others almost completely deaf, responded to the experiment, many being able to hear fairly clearly.

Isabelle Schaible, a pupil, heard music for the first time. Others were able to hear and distinguish between speaking and music, but Isabelle responded more completely than the others.

She sat with a radio headpiece over her ears. Her face almost shouted in her excitement. The strains of a dance orchestra were being received from a local station.

Instructors, pupils and visitors crowded about and watched her. She started beating time to the music with her foot. Any doubt that she was hearing was dispelled

Isabelle, whose home is at Lafayette, has been deaf from childhood. Instructors rated her "completely deaf."

The experiment in the use of radio in aiding the deaf to hear was conducted with the cooperation of J. F. Connell of the Capitol Radio Supply Company, 52 W. New York St., who installed the set and operated it, and O. M. Pittenger, superintendent of the school.

Signals When Music Starts

Isabelle could distinguish nothing when the set was tuned into a concert at Detroit. But when the loud tones of a local dance orchestra came through the phones she immediately responded, signaling with her hands to an instructor that she heard music.

When the music stopped and an announcer started talking she signaled she could not hear a sound, although persons with normal hearing listening in on other sets could hear perfectly.

A score of pupils, whose hearing was in all stages to complete deafness, submitted to the experiment. Only four or five did not respond. A number considered deaf could distinguish between speaking and music.

The first two pupils with whom the experiment was tried were Gertrude McKnight of Carmel and Mary Monfreda of Indianapolis. When the phones were placed to their ears their faces brightened. They expressed the opinion it was "fine" and could distinguish between speaking and music.

Leon Heinrich, South Bend, an advanced pupil, put the receivers to his ears. His face was a study for a moment.

"I can hear something like a street car," he said.

Instructors expressed the opinion he had felt the vibrations of a street car and the vibrations of the headset felt the same.

Compared to Phonograph

On the second test, when an Indianapolis station was sending, the pupil accurately and repeatedly distinguished between music and talking. He has been deaf since he was 5 years old.

Many of the children declared they were listening to a phonograph when the music was being played. It was explained that while some possibly had sufficient hearing to distinguish phonograph music, others had recognized the vibrations of the radio music as similar to those of the phonograph.

"I hear a merry-go-round," one little girl exclaimed the moment the phones were put to her ears.

Gladys Heavenridge of Muncie, listed as having no hearing, insisted she could detect sound. Julia Gulley of Winchester could distinguish accurately between music and speaking. Another girl said she could feel vibrations but did not believe she was hearing.

Some of the boys heard so well they were loathe to relinquish the receivers. They were listed as having partial hearing but not sufficient to go to ordinary schools.

Cleatus Greenwald, a pupil, said he could hear distinctly. He could distinguish between musical instruments and could distinguish speaking. Edgar Lloyd, who was listed as having some hearing, heard well, as did Ivan Lynch of Frankfort. Both boys repeatedly listened in and appeared to enjoy it.

Howard Paust of Richmond, deaf since he was a year old, heard when the Indianapolis station came in, but could not hear stations farther away. Joe Miller, another pupil, could distinguish between music and speaking.

Deaf Since Babyhood

Deaf since babyhood, Helen Skelton of Terre Haute insisted she could detect sound. Lola Atwood of Vincennes could feel vibrations, but did not think she was hearing.

Dorothy Jones of Anderson and Walter Brady of Muncie did not respond. Some of the instructors who have no hearing said they could detect nothing.

Intense interest in the experiment was expressed by instructors and pupils alike. They gathered around the receiving set and whenever any one succeeded in hearing there were smiles and congratulations.—[Felix F. Bruner in the Indianapolis Times.

For the Blind

A pathetic letter from a blind man in Highmore, S. D., was received by the Department of Commerce asking which branch of the Government was distributing radio receiving sets to blind people. The Department radio officials were forced to reply that the Department had no sets to distribute and knew of no appropriation from which such donations could be made.

It occurred to the Government officials, however, that there was an opportunity for some charitable organization to perform a great public service for those who cannot see. Most blind, they point out, have no means of receiving information or instruction except when they are read to. Since radio offers an audible means of instruction and entertainment and 570 broadcasting stations furnish programs free during practically every hour of the day, Government radio experts urge that a fund be started from which inexpensive radio receiving sets could be purchased for those unfortunates who are forced to spend their days in darkness. Radio broadcasters are furnishing the material, and some believe there are individuals or organizations who will bring these broadcasts to the ears of those who need them most of all.

Radio and Religion

Convincing proof of the value of broadcasting religious services was received by WGY, the Schenectady broadcasting station of the General Electric Company from a blind woman living in East Orleans, Mass., near Cape Cod. The paper was creased under each line of writing, and it was evident that the creased line was used by the writer to guide her pencil as she wrote the following appreciation:

Dear Sir:

"I am writing you a few lines this beautiful morning to tell you how much I enjoyed your good sermon Sunday afternoon, also the singing of 'Just As I Am,' and others. I heard every word of the sermon and singing, which was fine. I could hear just as plain as though you were in the room.

"What a wonderful invention. A friend and kind neighbor took me to his house to hear the radio. I am an old woman, almost seventy-five years old. Have been stone blind over twelve years, have not seen one ray of light. I take care of a crippled husband who is over eighty, cannot walk a step alone. I dress and undress him every day and wait on him. Sometimes the way seems dark, but my dear Heavenly Father gives me strength every day, and at night I say I am a day nearer home. I go to church or Sunday school and do enjoy it so much. I gave myself into God's hands over fifty years ago and he has never failed me yet. I always trust Him. He knows what is best for me. Pardon me for writing, but I did want to thank you for that service. May God bless you is the prayer of your friend.

Signed "....."

P. S. It is one of the most wonderful of all inventions to know that I can sit here in an easy chair way down on old Cape Cod and hear such lovely sermons and singing. God bless the man that invented it. I hope to hear you again sometime.

Signed "....."

Siffer Lemoine, radio engineer of the Royal Swedish telegraph Board, is in the United States studying the American radio systems and to confer with Government radio officials.

Jewett Buys DeForest

Outright purchase of the entire business, good will and patents of the DeForest Radio Telephone and Telegraph Co. is announced by President E. H. Jewett of the Jewett Radio and Phonograph Co., of Detroit.

Associated with Edward Jewett in the purchase are Theodore Luce, former Detroiter now associated with the New York and Chicago bond house of A. C. Allyn; Frank W. Blair, President of the Union Trust Co. of Detroit; H. M. Jewett, President of the Paige-Detroit Motor Car Company; and several other capitalists and radio experts.

As the result of the purchase, the Detroiters come into possession of 181 radio patents, among them the basic rights to the three-electrode audion bulb, which is an essential part of every long distance radio receiving or sending set. All other tube manufacture is conducted by virtue of license under DeForest patents. Among the other patents are several others covering radio equipment in general use, as well as a large number representing more recent development and research by Dr. Lee DeForest, and embodying startling new developments in the radio field.

The purchase also includes the fine new plant of the DeForest Company at Jersey City, the largest individual plant in the world devoted solely to radio manufacture, at which DeForest inventions are manufactured commercially. No announcement was made of the amount of money involved in the transaction.

Dr. DeForest remains with the company under a long-time contract as consulting engineer and is now, according to Mr. Jewett, giving a large share of his attention to the perfection of equipment by which the human voice is synchronized and reproduced in connection with moving pictures, thus adding a startling widened range of interest to the hitherto silent drama.

"Dr. DeForest is really the father of modern radio," commented Mr. Jewett in discussing the transaction. "Without his contributions to the art, commercial radio would not be possible. Like most inventive geniuses, the commercial side of his work has been distasteful and he is glad to turn over this factor to our group. It is our intention to make the name DeForest as significant to the general public of the best and the most advanced in radio, as it stands today among the experts. In accordance with this policy we will put behind the DeForest products every bit of Detroit enthusiasm and merchandising ability within our power.

"The affairs of the DeForest Company will be administered from Detroit, though we have no plans for any immediate change in the personnel or operating methods of the Jersey City factory.

"It is also possible that the DeForest purchase may eventually result in a large addition to the manufacturing facilities of the Jewett plants at Allegan."

High School Map

The radio amateur and broadcasting listener of Central Illinois will without doubt be interested to know that the Radio Research official staff of Springfield (Ill.), has copyrighted and is now putting on the market an up to date map of radio broadcasting stations in the United States. This is indeed a very high class map of great value to any radio amateur and novice. This map will retail at twenty-five cents each.

The map is put out in blue-print form, being made from a tracing that was drawn by members of the High School Radio Club. A great deal of hard and patient effort has been put forth in the preparation of this map and the completed product has certainly made a nit with radio amateurs and broadcasting listeners. The reader will perhaps be interested to know that when the drawing was completed some blue-prints were made from same and a sample map taken to each local dealer and a ready evidence of its merits can be judged by the fact that not only many amateurs complimented the map but forty maps were sold in thirty minutes.

One of the unique features of this map is a series of concentric circles, covering the United States, with Springfield as the center. The circles scale one hundred miles apart, thus enabling any listener to determine at once the approximate distance from which he is listening to a concert in any direction.

Radio Needs Trained Men

Radio is sweeping the country like wild fire. Thousands of dollars are being spent for expensive outfits. RADIO EXPERTS are needed everywhere to keep this equipment in order and to sell and install new outfits.

Be a Radio Expert

I will train you quickly and easily in your spare time, to become a RADIO EXPERT so you can install, construct, repair and sell Radio equipment. I am a **Graduate Electrical Engineer** and from actual experience I will give you exactly what you must know to make the really **big money in radio.**

FREE My Consultation Service to you is FREE. This outside help which I gladly give you is, in itself, worth more than the small cost of the Complete Course.

START NOW

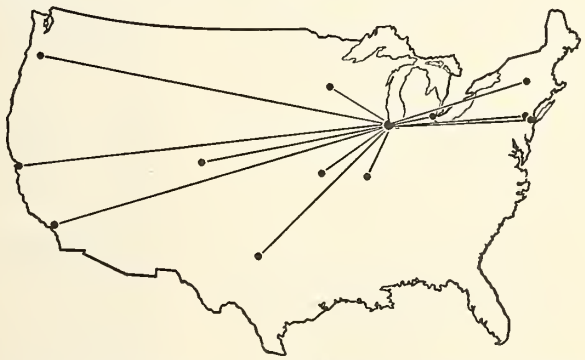
Don't let others beat you to the big money. **Start now** and within a few weeks' time I will train you at home, at an amazingly low cost, to become a RADIO EXPERT. Write for **"Radio Facts"** sent **free** without obligation.

A. G. MOHAUPT, Electrical Engineer
American Electrical Association
Dept. 28-5 4511 Ravenswood Ave. Chicago

WRITE TODAY

What One Tube Did In a Single Evening

New York City
Newark, N.J.
Detroit, Mich.
Kansas City
Minneapolis
Denver
St. Louis
Los Angeles
San Francisco
Portland, Ore.



Erla radio frequency transformers greatly improve the range and power of any receiving set, incorporating utmost efficiency and value. Results guaranteed. List, $4

Loud Speaker Was Used!

Typical of the amazing results that are being secured daily with the new Erla Duo-Reflex circuit, using but a single vacuum tube, is the experience of Dr. G. Edwin Farley, of Beverley Hills, Ill., who writes:—

"Between 9 p.m. and 2 a.m., Dr. Duff, a friend of mine, and I, listened to New York City, Newark, Troy, Detroit, Stanford, Tex., Kansas City, Minneapolis, Denver, St. Louis, Los Angeles, San Francisco, and Portland, —all, with the exception of the last, very clear and loud. *Most were heard on the loud speaker.*"

The basis of this new circuit, and the mainspring of its efficiency, is the Erla radio frequency transformer. Free diagrams of the circuit, with notes regarding its construction, are available. Ask your dealer or write.

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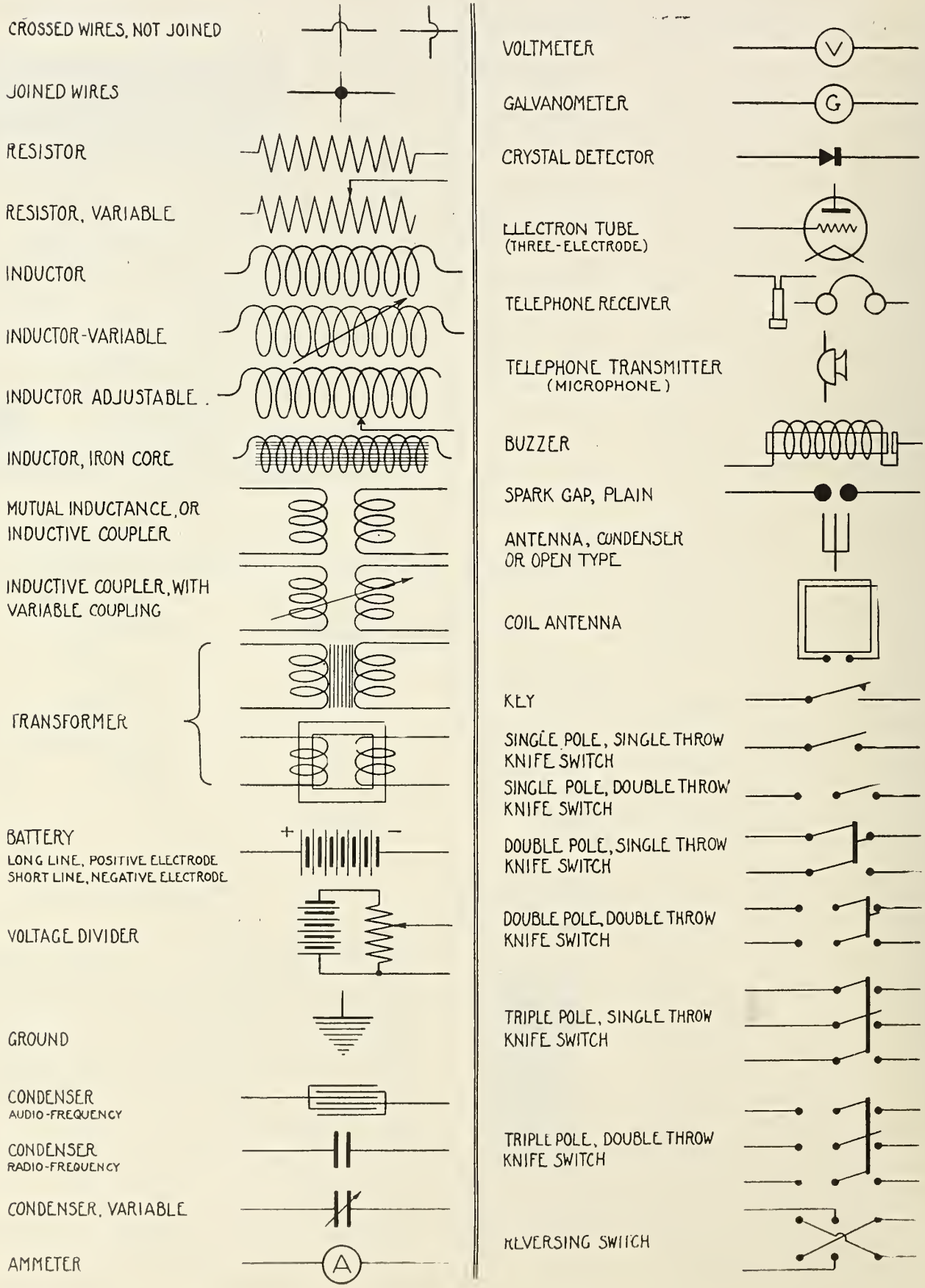
Watch for June Contest Announcement

Symbols Used in Radio Diagrans



Radio on Pacific

Although there are thirteen cables on the Atlantic, one cable only connects the United States with the Far East —that of the Pacific Commercial Company.

This cable has a limited capacity and is out of commission frequently for months at a time, due to the coral formation on the ocean's bottom between Guam and Manila. There has been some talk of another Pacific cable, but the physical conditions of the bottom are such that the laying of a second cable is a very expensive proposition. With the increasing facilities offered by radio, it is doubtful if the necessary money could be subscribed to finance such an undertaking, naval experts believe.

The Navy has several radio circuits across the Pacific, the giant of which, both in length and volume of traffic, is that from San Francisco to Cavite in the Philippines. About one-third of all traffic goes clear across the Pacific and the other two-thirds is relayed at Honolulu or Guam or both. There is a half hourly schedule between San Francisco and Honolulu so that this service is practically continuous. Commercial traffic cannot be accepted at the San Francisco Naval Station for Honolulu, although it is handled by points beyond Honolulu. Press traffic only is carried between San Francisco and Honolulu. Across the Pacific, Naval stations are located at Honolulu, Guam and Cavite and reaching to the southward, there is one at Tutuila in the Samoan Islands. From Guam to Japan, messages are transmitted by cable, although there is no reason why radio could not be used if Japan would open its stations to such messages.

In Alaska, the principal Naval radio stations are at Sitka, Ketchikan, Seward, Kodiak, Cordova, Dutch Harbor and St. Paul. As the Alaska cable is often out of commission, this chain is frequently called upon to accept commercial messages for the northwest. The Naval radio station at Cavite is in communication with French Indo-China and the Dutch East Indies, and a commercial traffic agreement with the respective administrations exists. Northward from Cavite are the circuits to Peking and Shanghai, the Vladivostok station having been returned to the Russians in November, 1922. Eastbound trans-Pacific traffic is sent direct from Cavite to San Francisco, this circuit having been in operation for more than two years.

Under a resolution adopted at the Washington Limitation of Armament Conference, the use of the two China circuits is limited to government traffic. Just why or by whom this was put in can only be surmised, for now China cannot even receive press by radio from America.

Radio "Letters"

France has introduced a new method of communication which combines the postal and radio service with her colonies. On Jan. 13, there was established "radio letters" which, when printed clearly, may be mailed to the transmitting station radioed to a receiving station and there mailed to their destinations. The charge is said to include postage at both ends of the route and two-thirds of the regular radio charges. The minimum involved a rate applicable to a twenty-word message. Radio letters follow the regular radiograms daily or are moved the second day as day messages.

Italy Progresses

The volume of radio traffic in Italy has increased at a surprising rate during the past four years, Trade Commissioner Osborne at Rome reports. In 1919, Italian statistics show only 50,000 words were transmitted, but it is now estimated that in 1923 this will increase to seven million words.

This month a new station at Coltano, Italy will be opened for Commercial traffic and direct communication between New York and Rome will probably be established. To-day this traffic is handled via Berlin, Paris or London.

Development in Brazil

Communication by means of radio telephony has been established between Son Paulo and Rio de Janeiro, following earlier unsuccessful attempts which were said to have failed on account of atmospheric difficulties, Assistant Trade Commissioner M. A. Cramer, reports to the Department of Commerce.

Send $1.00 to Radio Age, 64 Randolph Street, Chicago, and receive this middle-west radio periodical for six months. Regular subscription price is $2.50 a year.

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CHICAGO

Passengers on Moving Street Car Talk by Radio With Power House

SUCCESSFUL tests of carrier current, as a means of communication between moving street cars and the power station on the Third Avenue Railway to New York City, were recently completed by the General Electric Company. This is the first time that a moving trolley car has been able to keep in constant communication with headquarters and marks a new advent in this new science.

At the suggestion of the Third Avenue Railway, this new use of carrier current was tried. A transmitting and receiving set, similar to that used in any radio broadcasting station, was installed in the Brook Avenue sub station in the Bronx and a similar set was installed in one of the street cars. The messages, as broadcast from either the car or the sub station, instead of flying in all directions through space, were confined to the trolley wire, thus insuring privacy and direction of signals. Other advantages of carrier current over ordinary radio were the absence of static and the fading of signals. Persons who listened in and talked, either from the moving car or the power station, were unanimous in declaring the voice was as clear and distinct as any conversation they had heard over an ordinary land telephone.

In addition to being a means for instantaneous communication between headquarters and a trolley car, the same apparatus can be installed on an emergency or repair wagon. Then when this wagon is sent out on some trouble, by merely connecting the lead from the carrier current set to the trolley whether there is power in the wire or not, the workmen can be kept in constant touch with the repair barn. So as not to be dependent on trolley current, the telephone set is operated from storage batteries, which in turn operate a motor generator set, thus supplying the necessary energy for the vacuum tube transmitter and receiver.

On the New York street car, three fifty-watt Radiotrons were used for sending and an ordinary receiving set with one detector tube and two amplifiers of the UV 201 type for receiving signals. The two transmitters operated on a different wave length and by this means it was possible to carry on a two way conversation at the same time, just as is possible on the land telephone. Since these wave lengths were greater than 15,000 meters, there was no possibility of any interference with other broadcasting stations. Then too, the signals were confined to the immediate vicinity of the trolley wire so closely that even though a person had a receiving set tuned to this high meter wave length installed in his home along the route of the car he would be unable to hear any of the conversations.

Walter J. Quinn, electrical engineer of the Third Avenue line, in speaking of the tests, said:

"Operating delays usually occur through unforeseen causes such as fires, accidents and traffic congestion. Even with the best telephone service time is lost in reaching emergency crews and other employes who are charged with the duty of maintaining schedules and clearing up trouble. Where such employes are beyond reach of immediate telephone facilities, additional time is required in dispatching messengers for them. To improve this condition it seemed most logical to use the trolley wires and feeders of the system as a channel for the broadcasting of signals and messages, and with this in mind the General Electric Company and the Third Avenue Railway have been jointly experimenting for several months.

"The wires and feeders form a network covering the entire system which furnishes ready means on contact with all strategic points and also the means by which emergency motor vehicles may instantly make contact and be placed in communication with the central dispatching point. I think the tests concluded this week substantiate my belief, that the carrier current telephone will do just what we have been seeking."

This is the third use carrier current has been put to thus far by the General Electric Company. About a year ago it was first used to operate a street lighting system at Little Nahant, Mass., six miles from the power station at Lynn. Last fall it was successfully used in transmitting a telephone conversation over a 70,000 volt transmission line for a distance of forty miles out of Baltimore, Md. These tests were made with fifty-watt sets. Larger sets of 250-watt are being built by the General Electric Company which will make it possible to greatly extend the distances.

RADIO DEFIES STORM

Recently when a sleet storm which raged through the Middle West disabled telegraph wires, broadcasting station KYW of the Westinghouse Electric & Manufacturing Company aided news agencies, railroads, and brokerage concerns in relieving the ensuing distress.

Radio then returned to its original role as one of the protectors of public safety and, by broadcasting over a wide area warnings, orders, and news dispatches, enabled trains to be located and newspapers to come out on time and give out of town traders up-to-the-minute stock information which enabled them to put through valuable deals.

As soon as the storm was known to have spread over a wide area and reports began to come in that telegraph wires were down all through the Middle West, the officials in charge of Station KYW began to receive numerous requests from the managers of railroads and the press associations for assistance in dispatching trains and spreading news. Although not organized for this relief work, a temporary system of communication was established by Walter C. Evans, chief operating engineer of KYW in which the broadcasting station's powerful code transmitting set was put to use.

In a short time the code set was broadcasting over a wide are an appeal to broadcasting stations and amateurs located in the western portion of the Middle West to be on the watch for wrecked trains and those which were behind schedule. The persons hearing the call were instructed to communicate immediately with KYW, giving the station all available information. News began coming in at once by way of the other. Included in the first signals received was the information that a train running on a single track line had been wrecked and passengers and crew were in distress. Telegraph signals were also received from train operators telling of damage and where help was needed.

With this information officials of the Illinois Central railroad and the Chicago, Milwaukee and St. Paul railroad at once got into communication with the places at which train service was halted and by radio transmitted orders that soon straightened out a tangled situation.

Then word was received that because of wrecked telegraph lines the Belvidere, Ill., Republican and the Sterling, Ill., Gazette were severed from the news agencies. Late news bulletins were, therefore, read from the studio and the newspapers were enabled to fill their columns. According to letters received from the various editors all the broadcasted news bulletins came in clearly enabling them to make all their issues on time.

In the meantime as this relief work was being broadcast, Chicago brokers also reported that many clients in the Middle West were without accurate trading information. This situation was relieved when KYW greatly increased the scope of its daily market service.

The manner in which KYW met the emergency has greatly increased the value of the radio telephone in the eyes of those who for a short time were dependent upon its service, for it proved that radio could "carry on" despite the fury of the elements, which in the past have played such havoc with public safety.

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(See coupon on page 20.)

Radio in Czechoslovakia

Three radio-telegraph stations are now in operation in Czechoslovakia, and six are under construction, according to Consul Winans at Prague. The station of Brno, Moravia, opened for business last month, establishing communication with the Swiss radio station at Berne; a regular schedule is now maintained three times daily.

Czechoslovakia's principal radio-telegraph station is at Prague, the Capital, where a ten K.W. set has been in operation since June, 1920. Another smaller station is maintained at Vinghrady, which serves the airplanes flying between Prague, Warsaw and Vienna. Exchange rates and press reports are also handled by this service for the state.

At Kbely, near Prague, a 1 KW station is nearing completion for special service to the aviation field at Kbely and public service. Carlsbad, or Karlovy, another 1 KW set is being installed principally to handle traffic during the "cure" season.

A 5 KW station is in course of construction at Podebrady, Bohemia, which will eventually become the center of Czechoslovakian service. At this place there will also be erected a second station with two 50 KW generators to be used for international communication. It will be ready for opening next year. Moravaska Ostrava is to have a station for serving the air route and general business in this industrial center. Kosice, Slovakia, has underway another 5 KW station for general service, and a 5 KW set is planned for Bratislava, Slovakia, for the International Danube Commission and Danube shipping.

Danish Radio Laws

The wireless telephone has arrived in Denmark, according to Consul-General Letcher. He reports to the Department of Commerce that it is hoped radio telephony, now that its advantages have been clearly demonstrated there, will soon leave the experimental stage and enter into practical service.

Experiments to acquaint the public with this modern means of communication began in August, with direct wireless communication between Copenhagen and a Scandinavier-American Line ship off the coast of Norway while enroute to the United States. Recently the Danish Radio Company, which has installed nearly all the radio equipment on ships of that country, established radiophone communication between one of the Copenhagen telegraph news bureaus and Helsingr, about thirty miles away.

A delay in the natural development in the popular field has been caused through the fact that national laws forbid the use of all amateur radio telephone and telegraph apparatus. In spite of this law, however, there are said to be about 1,000 radio amateurs in Denmark. Several firms and institutions have succeeded in securing permission to operate for technical purposes. Nothing will be done to open the air to amateurs and public broadcasters, it is said, until after the International Radio Communications Conference meets in the spring.

Prospects for future developments in Denmark are believed to be good, if laws permitting the use of amateur apparatus are enacted.

Radio in Japan

Several Japanese private concerns are now permitted to broadcast Government reports, speeches and music by radio, the Government having relaxed its rigid policy, advices from Japan to the Department of Commerce state. Only a few financially sound companies in Tokyo and Osaka, and perhaps one or two other large cities, will be licensed. A broadcasting tax is required by the Government after April 1. The companies charge subscribers a fee for the service rendered, which the Government will collect, returning a percentage to the broadcasters. Individual users of broadcasting and receiving sets will not be permitted to communicate with each other, it is stated. Complete receiving sets will cost between twenty and thirty yen, or between $10 and $15, it is anticipated by Japan experts.

Radio on Aircraft

The air traffic commissioner of Denmark recently ruled that all airplanes must be equipped with wireless telephone apparatus. This is held as an important advance in both aviation and communication in Denmark. It is a progressive step not yet taken in the United States. Although ships of the sea must be so equipped, aircraft do as they please. After many accidents in aerial traffic over sea routes, with some loss of life, two aerial navigation lines have voluntarily begun to equip their aircraft with radio as a safety precaution. Rear Admiral Moffett, Chief of the Naval Bureau of Aeronautics, pointed out the necessity of radio equipment or at least pigeons on all aircraft several months ago. All Army and Naval planes are radio-equipped, at least when on long distance trips, and in addition carry pigeons.

H. A. Trask, director of the broadcasting activities of KSD, the *St. Louis Post-Dispatch*, is a tireless worker for the interests of the host of fans who own receiving sets. Among the many good ideas developed in the St. Louis station is the publication of a record of broadcasting stations, printed on heavy paper, a feature of which is a chart for tunings, making it possible for the receiving set operator to enter thereon the dial readings at which he heard the various stations. This of course makes it possible to go back to the same tunings by merely resetting the rheostats to conform with the entries on the record. A time-saver and a happy thought for the fans who want to scamper around the radio map with the greatest possible speed.

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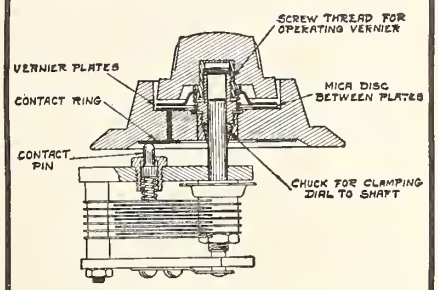
More Power, and Far Greater Selectivity



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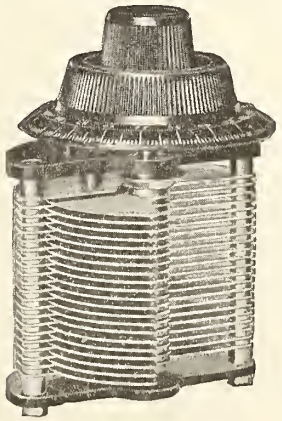

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High-Speed Radio

Successful experiments in high speed radio transmission between Army Message Center in the Munitions Building at Washington have just been completed. With new commercial apparatus, capable of sending mechanically from a perforated tape up to a speed of 100 words a minute and recording the messages in a saw-toothed ink line on a tape, a reception speed of sixty-five words a minute has been achieved. After a little practice, Signal Corps experts say, their operators will be able to mechanically copy the received messages visually as well as by ear, and in this way a great saving of time will be made in clearing traffic.

The Signal Corps is planning to adopt high speed systems such as commercial companies are using in trans-Atlantic work for trans-continental messages, and may order new mechanical radio equipment capable of operation at the rate of 200 words a minute. The practical value lies in the fact that when static interfering and only a few clear hours a day are available, a great number of prepared high speed messages can be sent through in a short time. The transcribing on message blanks can be done after reception by several operators.

An addition to the Army Radio Net was made in March when the Fort Bragg, N. C., radio station WZG was put in operation. A new 5KW tube set has replaced the single tube set at Fort McPherson, Atlanta, which was not powerful enough to operate over the Appalachian Range. A new station with high powered tube transmitters will be completed in Fort Leavenworth, Kans., in August, and Fort Douglas, Utah, will also soon have new high-powered equipment.

High speed transmitting and receiving apparatus will also be installed between Washington, Fort Leavenworth, and Fort Douglas, and possibly at Fort Sam Houston, Tex. In good winter weather, when static does not interfere, it is expected that Washington can clear traffic to Fort Douglas, Utah,but in the summer it will probably be necessary to relay through Fort Leavenworth, Kan.

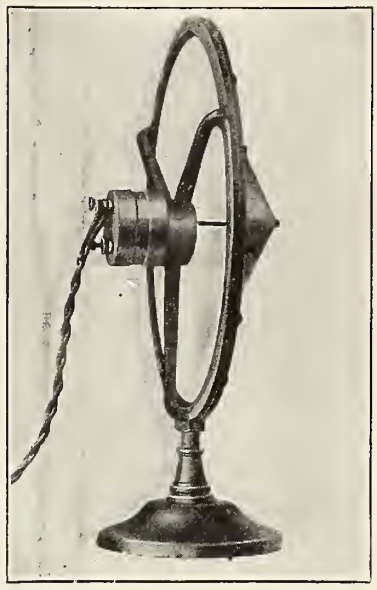
The Signal Corps is now assigning waves lying within the bands recently allocated to the Government by Secretary Hoover's conference, in this way cooperating toward decreasing the interference so prevalent.

Engineer for Bureau

Dr. August Hund, of Berkeley, Calif., has been appointed as electrical engineer in the radio section of the Bureau of Standards, Department of Commerce. Dr. Hund is a Doctor of Engineering, having graduated from the Technische Hochschule, Carlsruhe in 1913. He served two years under Steinmetz in the General Electric Company, and is the author of a technical book on frequency measurements. For the past several years he has been doing graduate work at the University of California.

New Loud Speaker

A loud speaker with a non-metallic sounding board is introduced by the Pathe Phonograph & Radio Corporation. It is claimed for this instrument that it reproduces exactly the sounds sent out by the broadcasting station,



whereas the large diaphragm on the "Pathe" gives a loud and clear signal from all its surface. The instrument is exceptionally light and is of attractive appearance. In Japan finish it retails at $22 and in nickel finish, at $24. Further information may be obtained by addressing Trade Editor, Radio Age.

Radio in Cabinet?

The creation of a Department of Communications including radio is suggested in the report on the Re-organization of the Executive Departments submitted to the Joint Committee of Congress by the President recently.

The Committee headed by Mr. Walter F. Brown, suggests that the Post Office Department be re-named the Department of Communications and that it include an Assistant Secretary for Telephone and Telegraph, including radio.

In the report Mr. Brown says in part: "The only important change contemplated is the addition of a bureau (to the Post Office) to develop and extend telephone and telegraph communications, including wireless, for the general public benefit."

Apparently the Navy would retain its communication system as would the Signal Corps, but it is evident that radio regulation would be transferred from the Commerce Department to the Department of Communication, although the Bureau of Navigation, under which the radio section operates today, is left in the Commerce Department.

Although the report is labelled as recommended by the President, his letter of transmittal states that with few exceptions, the changes have the sanction of the Cabinet, and adds that it is his hope that the suggestions will be of assistance to the Committee. Further than that, the President does not appear to urge its adoption.

Baseball Talks

Three addresses of interest to every baseball fan and of special interest to the American boy were broadcast from WGY, the General Electric Company's Schenectady radio station, Friday evening, March 9. John A. Heydler, president of the National Baseball League spoke on "Helpful Hints on Baseball for the American Youth;" Col. T. L. Houston, part owner of the New York Yankees, discussed "Baseball as a Business," and William O. McGeehan, sporting editor of the New York Herald, had something to say about Babe Ruth and the home-run king's efforts for a come-back. All three addresses were photographed by the Pallophotophone in New York recently.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912,

Of Radio Age published monthly at Mount Morris, Ill., for April, 1923.

State of Illinois } ss.
County of Cook }

Before me, a notary public in and for the State and county aforesaid, personally appeared Frederick A. Smith, who, having been duly sworn according to law, deposes and says that he is the Editor of the Radio Age and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Radio Age, Inc., 64 W. Randolph St., Chicago, Ill.; Editor, Frederick A. Smith, 64 W. Randolph St., Chicago, Ill.; Business Managers, M. B. Smith, 64 W. Randolph St., Chicago, Ill.

2. That the owner is: (If the publication is owned by an individual his name and address, or if owned by more than one individual the name and address of each, should be given below; if the publication is owned by a corporation the name of the corporation and the names and addresses of the stockholders owning or holding one per cent or more of the total amount of stock should be given.) Radio Age, Inc., 64 W. Randolph St., Chicago; Frederick A. Smith, 64 W. Randolph St., Chicago; M. B. Smith, 64 W. Randolph St., Chicago; J. H. Lohbeck, St. Louis, Mo.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the six months preceding the date shown above is —. (This information is required from daily publications only.)

Frederick A. Smith.

Sworn to and subscribed before me this 23rd day of March, 1923.

Seal.

Harriet Dillon,
(My commission expires June 5, 1923.)

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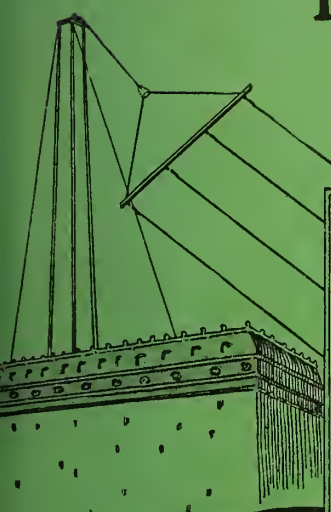

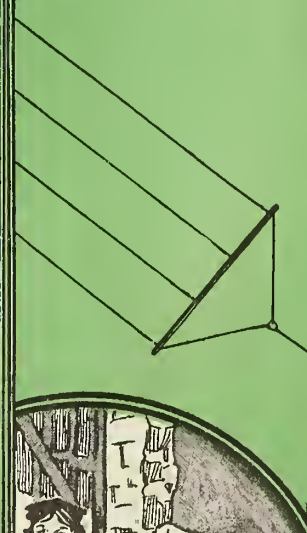

IN THIS NUMBER

How To Build The New Kaufman Receiver

By Frank D. Pearne

What About Your Antenna?

Pick-up Records and Hook-ups

By Our Readers

Complete Corrected List of Broadcasting Stations

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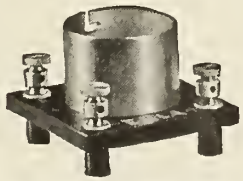
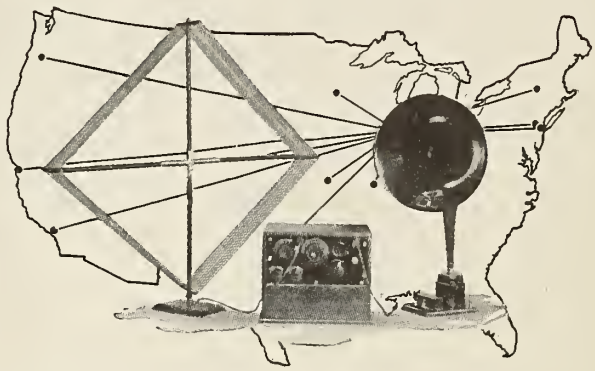
Erla fixed condensers reveal markedly superior accuracy, being exactly calibrated and individually tested. Made in eleven sizes, 35c to $1 each



Erla sockets are unmatched in beauty of finish and excellence of workmanship. All parts triply nickeled. Polished Radion base. List, $1.

Dealers and Jobbers: Erla leadership in research and quality manufacturing spell increasing opportunity for Erla dealers. Rapid turnover and liberal discounts yield healthy, substantial profit



Win the Erla Duo-Reflex Receiver Shown Above

The announcement of the Erla Duo-Reflex circuit, the most powerful single-tube circuit ever built, has occasioned a tremendous volume of scientific comment.

Research engineers and advanced experimenters alike have been stimulated to renewed endeavor by the fundamental improvements revealed in its construction.

To encourage scientific investigation among amateurs as well, growing out of a clearer understanding of the unique operating principles disclosed, the following prizes are offered:

1. For the best explanation of the action of the Erla Duo-Reflex circuit—One Erla Duo-Reflex Receiver, mounted in a beautiful mahogany cabinet, as shown centrally above.

2. For each of the ten next best explanations—One Erla Reflex transformer.

All manuscripts must be mailed not later than midnight, June 10th, to receive consideration. Judges will be F. D Pearne, Technical Editor of Radio Age and E. J. Wiggins. Chief Engineer of the Electrical Research Laboratories.

Instructions for building the Duo-Reflex circuit may be obtained from any leading radio dealer. Ask for Erla Bulletin No. 13, or write us direct.

Electrical Research Laboratories
Dept. M 2515 Michigan Ave., Chicago

ERLA

RADIO AGE

The Magazine of the Hour

Volume 2 *JUNE, 1923* *Number 5*

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Showing 'Em How

RADIO AGE has made a specialty from the first issue forward of publishing articles and illustrations which enable radio beginners and more advanced radio students to build their own receiving sets. In fact this magazine was started more than a year ago with that avowed intention. For that purpose it acquired the services of technicians who were best able to instruct our readers in construction and operation.

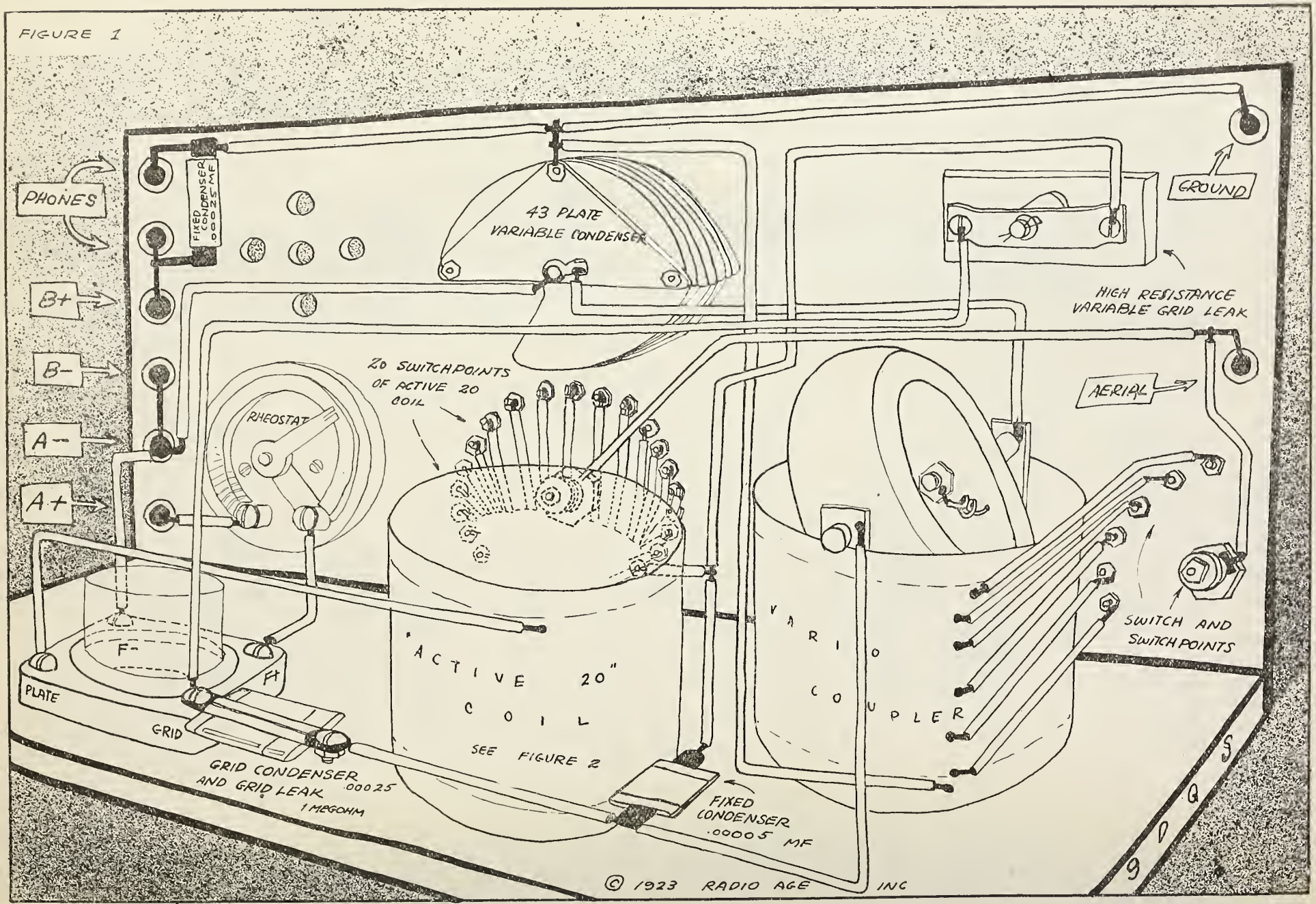
The other day a foremost manufacturer of radio receiving sets raised the question with us as to whether such a continuous course of instruction in making home sets would not logically decrease the demand for ready-made complete sets. In other words was not Radio Age injuring the business of the manufacturer of complete sets?

Our answer was an emphatic negative. Every reader of Radio Age who makes his own set and operates it successfully converts an indeterminate number of other persons in his neighborhood to radio enthusiasm. Some of his neighbors will proceed to subscribe to Radio Age and make their own sets. A far greater number will begin to look about for a ready-made set, because this greater number are either not technicians or they have not the necessary time to drill panels, wind coils and hook up a circuit.

It follows, of course, that the more home construction is encouraged the greater the demand for parts and accessories at the radio shops. But that is not the point. It is the construction of sets at home that shows communities what radio sets can do and makes communities want the manufacturer's radio sets.

In any event a careful program of instruction to the home laboratories brings growing circulation and therefore does not need justification. It justifies itself.

—The Editor



Back panel diagram of the new Kaufman receiver

RADIO AGE
"The Magazine of the Hour"
M. B. SMITH, PUBLISHER
PUBLISHED MONTHLY
FREDERICK SMITH, EDITOR

The New Kaufman Circuit

By F. D. PEARNE

IN THESE days, when new circuits are born overnight, it is a pleasure to occasionally discover something which is really original and worth while. Most of the so-called new circuits only consist of old ones made over, or changed in such a way that better results are obtained. The Kaufman circuit described in this issue has a basic action which is new and never before used. It is the invention of Mr. Wolff Kaufman who modestly claims that he is not a radio engineer, to which he attributes the fact that had he been an engineer, he probably would have been so deeply ensnared in the conventional circuits of today, that he would not have stumbled onto the new idea.

While we don't doubt Mr. Kaufman's word, it might be well to say right here, that he has slipped over a pretty good circuit for an amateur, and we hope that he will continue to "stumble" onto more of them and give us all a chance to hear about them. The ease of control and the elimination of interference, which are characteristic of this circuit, not to mention the simplicity of the arrangement, will at once appeal to the amateur who wants to try all the new ones.

With the use of an ordinary vario-coupler, it may be adjusted to any wave length up to 1000 meters, which is a wide range to cover without the loss of considerable energy on account of "dead end" effects.

The set is easily constructed and is sensitive to both local and long distance reception. Referring first to the conventional drawing shown in Figure 3, he shows how the oscillations are conducted from the aerial into the set in two paths, one path taking a course through the "active 20 coil" which will be explained later, and the other passes through the aerial inductance to the ground. This aerial inductance consists of the ordinary primary winding of the vario-coupler with its usual contact taps for the switch, with no change excepting that it will be noticed that a 43 plate variable condenser is connected between this aerial inductance and the rotor. This gives a combination inductive and capacitative coupling between the two coils of the coupler.

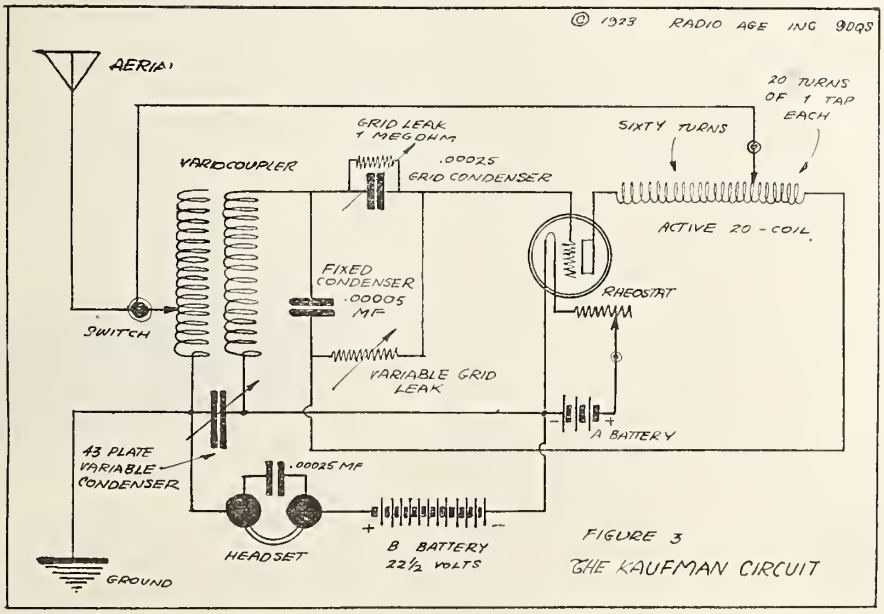
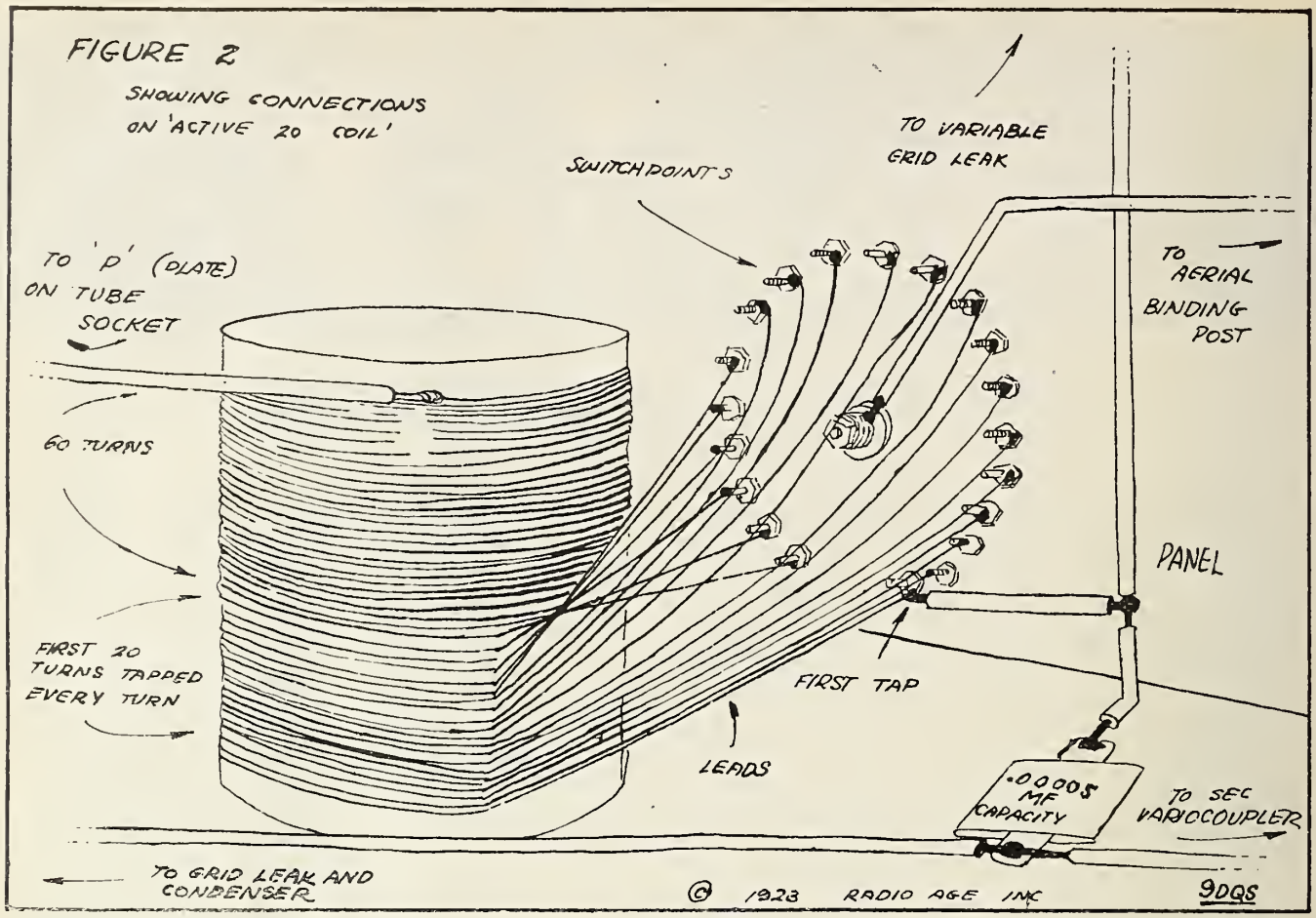


FIGURE 3
THE KAUFMAN CIRCUIT

The energy usually is transferred from one coil of the coupler to the other by induction only, but in this case it is further aided by the capacity of the condenser. The energy in the plate circuit, passes through a certain number of turns on the active 20 coil, where it divides, one part of this circuit being tuned in resonance with the energy coming in on the primary circuit, impressing itself upon the primary coil of the coupler, while the other portion is tuned to the energy impulses of the grid, reaching the grid through the .00005 fixed condenser. This of course all occurs at radio frequency.

Now while this is going on the detector tube has rectified some of the energy received from the aerial, and passed it around by way of the active 20 coil to the aerial inductive. From here, the radio frequency, or rectified energy takes the easiest path down through the head phones and "B" battery. While this has been going on, the radio frequency energy which was sent through the primary of the coupler, has been passed from the primary to the secondary to the grid of the detector tube.

Mr. Kaufman states that it has been found that the standard regenerative circuit makes use of but little more than 50 per cent of the energy received upon the aerial, but he believes that the excellent results obtained in his circuit are due to the fact that he reaches nearly 100 per cent by



supplying rectification at more than two points. By his arrangement the incoming wave is only partially rectified at first, but later, after being tuned to resonance, is almost all rectified. By this clever arrangement all the several rectifications are added together, resulting in a great increase in the signal strength.

The addition of the second grid leak shown on the drawing some distance below the usual leak is absolutely necessary, as the circuit will not operate, or at least will not function very well without it. Just what the action of this second leak is, Mr. Kaufman states that he does not know, but hopes to explain it in detail later. The grid condenser is of the fixed type having a capacity of .00025 M. F. This is shown in the drawing as being of the variable type, but this is not necessary, but will aid in the final adjustment.

It will be noted that the condenser connected across the active 20 coil and the grid circuit is designated as .00005 M. F. This is a very small capacity as condensers go, but this has been found to be just right for this purpose and a condenser of any other capacity must not be substituted. The rest of the circuit with the exception of the active 20 coil is made up of the standard apparatus which can be obtained at any radio store, and is plainly shown in the drawing.

The Active 20 Coil.

Figure 2 shows a drawing of the active 20 coil, which, while not hard to build may be found a little tedious on account of the many taps which must be taken off from the winding. A pasteboard, or bakelite tube, having a diameter of 3⅞ inches on the outside is used for the job. This should be about 5 inches in length and is wound with 80 turns of No. 22 cotton or silk covered magnet wire. In order that no short circuit will be made where the taps are taken off, it is better to use double insulation on the wire. Wind 60 turns without bringing out any taps and beginning with the 61st. turn bring out a tap on each turn.

This will make 20 taps in all, which should be connected up to the switch in their regular order as shown in Figure 2. Standard switch levers with knobs can be obtained in any length from 1 1 to 1½ inches. As it will require almost the entire space of the circle in the mounting, to accommodate the 20 taps, it is suggested that a switch lever of at least 1¼ inches in length be used, as this will not crowd the contact points too close together.

The taps as shown in Figure 2, are taken off from the lower end of the coil, the starting end of the coil being connected to the plate connection of the socket and the last tap of the switch is connected to the .00005 M. F. condenser. If these connections are reversed, the set will not function at all, so one should be careful to see that the connections shown on the drawing are faithfully followed out.

Panel Arrangement.

Figure 1. is a rear view of the panel showing same fastened to a baseboard fastened to it for the purpose of mounting those parts of the set which are not located on the panel. The arrangements of the parts as shown in this drawing is merely a suggestion and it is not necessary that they be mounted exactly as shown, however this layout, will be found to be about as good and compact as any which may be made. In any event the grid condenser must be placed on the grid contact of the socket, so that this lead

(*Continued on page 23.*)

What About Your Antenna?

By FELIX ANDERSON,

Radio 9DQS.

WHILE riding downtown on a certain branch of the elevated railroad of Chicago, I caught a bit of conversation between two BCL's (Broadcast Listeners), who were discussing the various merits and demerits of the antennas and their construction as they appeared on the roofs of the houses we passed. Evidently they were dyed-in-the-wool fans, and their conversation—I didn't mean to eavesdrop, but I couldn't really help hearing what they said—as I heard it, intimated that from their actual personal experiences, they had found that by giving proper attention to the aerial systems of their receiving sets, they had almost doubled their receiving ranges, and had increased the volume of their sets to a remarkable degree.

Probably less attention has been given to the aerials of receiving and transmitting sets than any other part of the entire radio system, and a few practical suggestions to the reader, as to the type, construction and care of antennae, are certainly in order.

Many of our BCL friends were smitten with the radio craze in midwinter, and with the usual haste of a fan, looked over the house he occupied, and probably several adjacent houses, went to a radio supply store, procured antenna wire and as fast as possible, strung an antenna between two elevated points without regard to theory, efficiency, appearance, or any other points in particular, except to have a wire up in the air, and call it an aerial. Now in all probability, haste can be justified because I am sure that no one is especially enthusiastic about hanging over a cornice or clawing up over a roof or a gable in bitter cold weather, trying to make an approved splice or an ultra soldered connection.

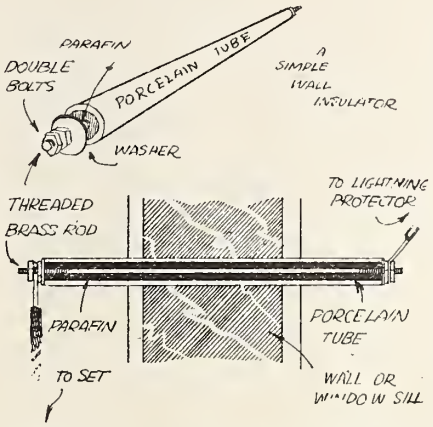


Figure 2. A simple, inexpensive lead-in insulator can be constructed from a few odds and ends which usually are found in an experimenter's junk box. The efficiency of such an arrangement amply pays for the time expended in construction.

But now that more clement weather is here, there is an opportunity to overhaul these hastily constructed antennas and apply some newly acquired knowledge to a new and better system. Much research work, experimentation and calculus has proved conclusively that an aerial is vastly something more than a wire strung between two elevated points in the air.

Recent tests have brought about the conclusion that probably the most ideal aerial for a BCL is a single wire from seventy to one hundred feet long, with a height of about thirty to forty feet above the ground. A longer antenna will give more volume, but for the real DX (long distance) BCL, something which will tune to a sharp wave and assist in shutting out interference is desired. Hence the shorter aerial. Length may be added, to be sure, but is it advisable to keep the antenna at a maximum height of from 35 to 40 feet.

If a more elaborate system is desired, a small inverted "L" type or a small cage of about 6 inches in diameter may be used and about the same dimensions as the single wire adhered to. However a single wire is more immune to static and to other atmospheric disturbances, and tunes very much sharper.

Tests have shown that, due to corrosion, many aerials have decreased as much as twenty per

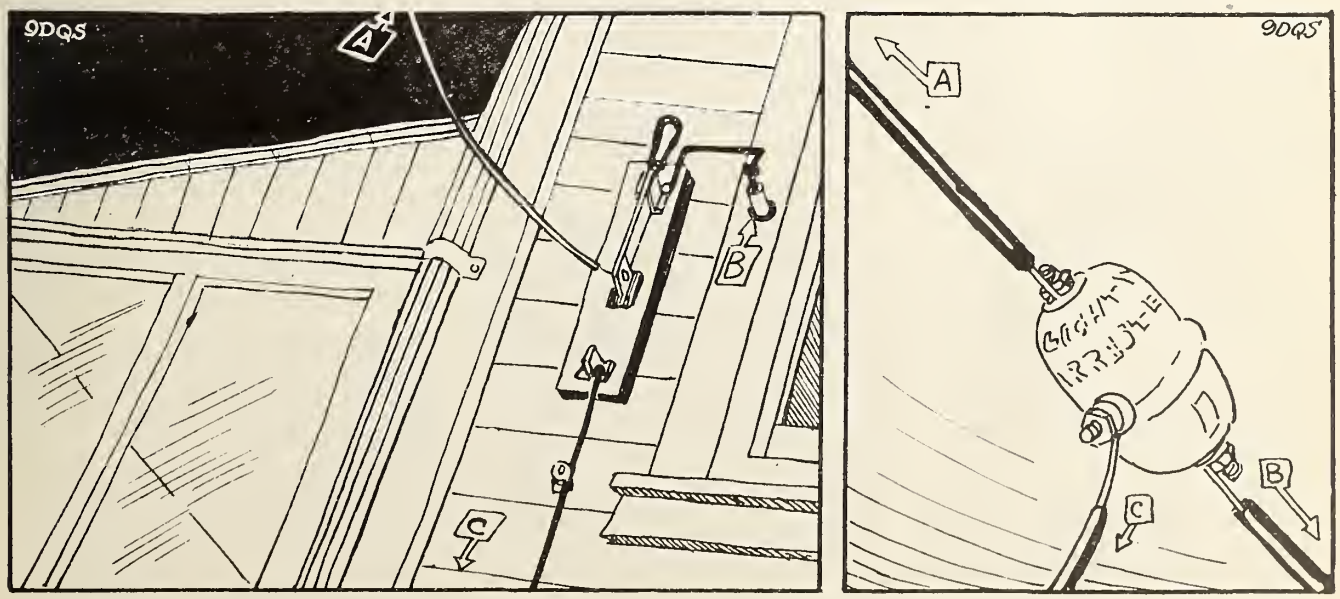
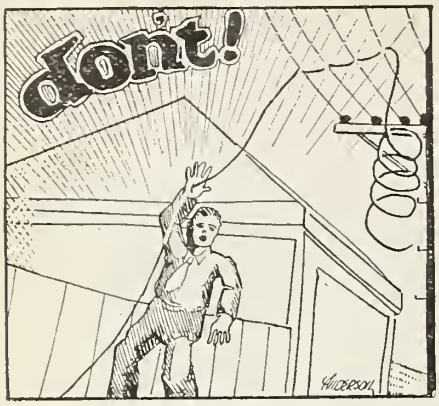


Figure 1. On the left, connections on the lightning switch are shown, A going to the antenna, B to the set and C to a separate lightning switch ground. On the right, a type of lightning arrester now on the market, with the connections A to antenna, B to the set, and C to a separate ground.



Don't throw aerial or guy wires over wires which you do not know anything about. A severe shock, even death, may be the consequence of your thoughtlessness.

cent in efficiency. All bare antenna wires copper, bronze or aluminum are subject to corrosion after a period of a few weeks, especially so in cities, where smoke, soot and grime are likely to collect on the aerial wires. This oxide and sulphide adds to the resistance of the system, and of a consequence signal strength is decreased. The ideal wire to use in such a case, is a number 12 or 14 enameled solid copper wire. Of course, indoor antennas are not subject to this defect.

Much has been said about antenna insulator, and it has been found that a long corrugated glazed surfaced porcelain insulator, carefully constructed to drop moisture and snow is about the most ideal type of insulator to use. Antennas should be lowered at frequent intervals, and these insulators should be cleaned of soot and grime, as they do not function as well with a thick layer of highly resistant foreign matter.

For the ideal aerial the lead in should be firmly soldered to the collecting portion of the aerial, and should be brought down to the lightning arrester, on the outside of the building. Many good types are now on the market, which can be connected with ease, and which will serve the purpose very well. If a lightning switch is to be used, it should be connected up as in Figure 1. As summer approaches, it is imperative that this lightning hazard be attended to.

The danger of lightning does not really exist in the lightning actually striking the wires, but in the fact that the aerial acts as a condenser which is capable of accumulating a powerful charge of electricity, which if not properly dissipated into the ground may discharge into some nearby object from the lead-in end of the aerial. If the object is inflammable, dire results may follow.

From the lightning arrester, the wire should be lead into the building through a well thought out arrangement. Never take a bare wire through a window and close the sash down on it expecting to receive long distance; 9½ times out of 10 you won't. The cheapest lead in you can make, is a porcelain tube, extending 3 or 4 inches outside of both sides of the wall with a brass rod imbedded in parafine as shown in Figure 2. An insulator of this kind is inexpensive and has so many good qualities that a few moments work constructing it will amply repay the reader to install one.

Once inside the house, the aerial lead should be made as short as possible, to the set. From the set, the wire should go to the ground, which will be treated in a separate article in a succeeding issue. At no time should the antenna run parallel to the ground lead of the set for any great distance.

In the course of conversation between the two BCL's on the elevated train, the subject of deaths due to the throwing of aerial wires over high tension power lines, was entered upon, and in connection with this, it should be emphasized that under NO circumstances should a novice or another radio fan so place his antenna that it crosses wires of any nature. Current newspaper accounts probably sound a more convincing argument in this connection when they publish articles relating the tragedy of some careless BCL who has met an untimely end merely because this oft sounded warning was disregarded.

If poles are used, they should be firmly guyed in order that no casualities might might occur due to falling masts, etc.

Never take a chance at climbing a pole which in any way looks doubtful. Numerous instances have been brought to my notice where dire results were unwittingly accorded due to such hazardous ventures. If a pulley is used, a good stout hemp nonshrinkable rope should be used, and should it in any way show wear—pull another one through, it's cheaper, will save time and perhaps your neck. Never pull antenna halyard quite tight. Allow room to give for wind, sleet, snow and shrinkage.

Careful placing of an antenna is always advisable. Never place it parallel to power lines as the interference from this source is a never ending amount of trouble. It should be placed as near to right angles as possible. If a tree is near your aerial move the aerial, as every little leaf and fibre in the tree will act as a miniature wireless sponge, and after they get through soaking up the signal, there won't be much left for your set to acknowledge.

Don't climb masts or structures that are in any way doubtful. The fellow who does it deserves to be classed in the same category as the one who looks into the wrong end of a loaded shotgun!

If you can't put up an aerial because of any of the above reasons, put in an indoor antenna in the attic, or use the lighting system of your home, in connection with any of the standard plugs now on the market. Unusual results have been obtained with this type of antenna, and it has often solved the problem of an adverse landlord. If none of the above methods can be realized, install a loop aerial set, with a suitable receiver.

As a last straw, don't despair, for if you have any problems of this nature, send them to the technical department of this magazine with the concise description and sketch of the matter involved and it will be answered in the usual way through our technical department of questions and answers.

Washington Y. M. C. A. on Air

The Washington YMCA has filed an application for a 50-watt Class A station with the Department of Commerce. A feature of the new transmitting set, located in the "Y" building on G St., is that the plate voltage is derived from a 468 unit storage battery instead of the usual method of employing a direct current generator. This station will broadcast talks on religion, education and physical culture, paying especial attention to matters of interest to boys. The station has been inspected, and it is expected that a license will be issued to the YMCA within a few days, assigning a wave length of 283 meters.

Broadcasters Win Big Point in Music Fight

IT is with deep gratification that the National Broadcasters' League is enabled to announce to broadcasters, as well as to millions of receiving set owners who love music, that a very important point has been gained in the league's effort to restore popular programs. This good news to broadcasters and fans is embodied in a special telegram to the National Broadcasters' League headquarters signed by M. E. Tompkins, chairman of the committee on broadcasting relations of the Music Publishers' Association of the United States. This announcement is in effect that the association members who wish to do so may permit broadcasters to use their catalogue without fee. The telegram from Mr. Tompkins reads as follows:

New York, N. Y.,
National Broadcasters' League,
Frederick A. Smith, Secretary,
Chicago, Illinois.

Action reported morning papers does not bind any members National Association sheet music publishers. Members accepting proposal committee permitting until further notice broadcasters right to use catalogues without fee will individually notify all broadcasting stations. Suggestions of committee were accepted by majority vote. Send complete list membership your league so our membership can address them.

(Signed) TOMPKINS
Chairman Committee Broadcasting Relations.

Broadcasters and music-loving fans will be further pleased to know that the committee taking this action represents the group of music publishers of the United States who produce a large part of the highclass songs and musical compositions. This association has no connections with the American Society of Composers, Authors and Publishers.

Representatives of the National Broadcasters' League have continued their efforts to bring about an arrangement with the authors and composers, but without results. The league representatives apparently have only succeeded thus far in convincing the authors' and composers' organization that under no circumstances will the broadcasters submit to a direct tax for the use of copyrighted music.

However, this situation is not so dark as it looks. While the authors' and composers' society claims to maintain control of the popular music production, there are scores of independent music publishers who have shown immediate interest in plans of the league for distribution of music to broadcasting members. Several of the biggest producers of popular or jazz numbers already have submitted to the league their catalogue with absolute authority to select for broadcasting the numbers regarded as most desirable.

As the May issue of Radio Age indicated, the supply of popular music is not at all confined to so limited a source as the neighborhood around 45th Street and Broadway, New York.

On the contrary, all over the country there are good song writers, good music composers and enterprising publishers eager to cooperate with the National Broadcasters' League, and not only restore good musical programs for radio, but vastly improve them.

Further details as to how this great movement in behalf of radio is being conducted by the National Broadcasters' League are being mailed to the members as rapidly as developments justify. It now looks as if the music situation would be adjusted permanently and on an extremely satisfactory basis, both from an artistic and financial viewpoint, both for the broadcasters and music loving fans.

Following is the official detailed announcement of the Music Publishers' Association of the United States as sent to Radio Age by mail following its telegraphic advice. The statement shows the attitude of the Association relating to radio music generally.

Official Announcement.

Permission to broadcast copyrighted music by radio without charge, pending the time the radio broadcasting situation is stabilized and placed on a commercial basis, is recommended to publishers by the Music Publishers' Association of the United States in a report of its special Committee on Radio Broadcasting, which has been accepted and adopted by the Association. Most of the publishers of popular music through action of the American Society of Composers, Authors and Publishers, recently forbade broadcasting stations to use their music except upon payment of a license fee to the society, thus precipitating an acute controversy between the popular publishers and the radio broadcasters.

M. E. Tompkins of G. Schirmer, Inc., publishers, Chairman of the Committee, in a statement issued yesterday said: "Our Association, which has been in existence since 1895, represents particularly the so-called 'standard' publishers, which make up a majority of its forty-nine members, as distinct from publishers of popular music although a number of the latter also are members.

"Our committee has been carefully investigating the broadcasting of copyrighted music since last November. In our report, just adopted by the Association, we point out that music publishers are vitally interested in radio broadcasting as a great future user of music and that our rights in the use of our copyrighted music in public performances must be protected. However, we appreciate the fact that radio broadcasting is still in a chaotic and experimental state and that, while ultimately it will have to be placed on a commercial basis if it is to develop its potentialities, nevertheless the commercial side of the broadcasting problem has not yet been solved.

"In view of these facts and also because we desire to cooperate in developing the music possibilities of radio, we believe that we should allow the use of our copyrighted musical compositions for broadcasting without charge for the present, and without prejudice in our rights."

While the action of the Music Publishers' Association does not bind its members, but merely recommends, it is understood that most of the large standard publishers in its membership will follow the recommendations of the Association. The following representative standard publishers have definitely decided to follow the recommendations: Carl Fischer, G. Schirmer, Inc., C. H. Ditson Company, John Church Company Boosey & Company, and Hinds, Hayden & Eldredge of New York City; Oliver Ditson Company and B. H. Wood Music Company of Boston; Paul A. Schmitt of Minneapolis and Clayton Summy of Chicago.

The action of the Music Publishers' Association will make available over the radio a great quantity of the best modern music by orchestra, band, choral and individual performers, and copyrighted arrangements and orchestrations of the world's best music of all time.

The decision of the publishers was based largely upon the following facts and conditions with respect to radio broadcasting, according to the report of the committee:

"The outstanding fact about radio broadcasting from the standpoint of both willingness and ability of broadcasting stations to agree at present to some practical form of compensation for use of copyrighted musical compositions, is their failure, as yet, to find a method of collecting a proper share of the expenses of broadcasting from its beneficiaries, that is from either the various elements of the radio industry or the receiving public. This, of course, does not in any way affect the merits of the question, but it is clear that it does present per-

plexing difficulties to the broadcasting companies.

"While the possibilities of the radio as a transmitter of educational and current informational matter undoubtedly are great, it is generally expected by those who have investigated this question, including radio experts themselves, that entertainment must comprise the popular feature of it. Music has been found essential to the success of nearly every form of public entertainment, and to this radio broadcasting appears to be no exception. Music is the one broadcasting possibility of almost universal appeal.

"Up to the present time the music broadcasted by radio has not, generally speaking, been of a sufficiently high quality to be a factor of importance in creating a further public appreciation and demand for music itself. Eliminate ing the novelty feature of radio, it is very doubtful if the musical side of it would as yet have had any great public appael. Much of the music broadcasted is merely that of a phonograph or reproducing piano, not a little of which is really for advertising purposes. With rare exceptions, no truly great artists have performed over the radio.

"It is not unreasonable to expect, however, that ultimately such scientific perfection of radio broadcasting and receiving apparatus will be attained and arrangements made with so much of the world's best musical talent that radio will be an established and important source of music on a commercial basis. When and if this time arrives, it will be vital to the welfare of the music publisher that the radio branch of the music industry should properly recompense the publishing branch, upon which it will be dependent for its existence and prosperity. The failure of publishers in the meantime to safeguard their rights may make the future enforcement of them difficult.

"The difficulties of establishing radio broadcasting on a commercial basis, which apparently is necessary before it can become an important direct source of revenue to those who participate in it, including copyright owners, are great but not unsurmountable. While it is impossible to predict how the problem will finally be worked out, nevertheless there are several possible solutions. Many persons believe that radio broadcasting must be placed under government regulations and control. Under such conditions all producers of radio equipment who are the commercial beneficiaries of broadcasting could be licensed and the proceeds used to pay the expenses of broadcasting. Some even expect that the radio may ultimately be of such universal use that the government can undertake broadcasting as a public function. It is perhaps more likely, however, that through the control of basic patents a few radio companies can develop broadcasting and reimburse themselves by including the expenses in the price of the patented radio parts or from fees received for licenses granted to other manufacturers. Another possibility is that the radio interests will be able to finance broadcasting as a common promotional problem of the industry, perhaps cooperatively through a trade association. Although seemingly impossible, science may yet produce a method by which the receipt of radio messages can be confined to those who pay for the service.

"Whatever the method proves to be, it must and soon will be found by the radio industry. The radio broadcasters will then be able, and undoubetedly willing, to reimburse all who are essential to the success of their business and those services they use, including owners of copyrighted musical compositions."

The President of the Music Publishers' Association is George Fischer, of J. Fischer & Bro., New York.

They Start Young

Babies now cry for radio. The new national pastime has invaded the nursery and many mothers are adopting radio waves as pacifiers. A mother of six children, the oldest eleven years old, writes WGY, the Schenectady broadcasting station of the General Electric Company that her youngest child, aged fourteen months, is already a fan. Mrs. Robert Barber of Rensselaer, N. Y., writes as follows:

"I wonder if it would interest you to know that I think I have the youngest radio listener. My baby is fourteen months old and she walks to the desk where I have my crystal set and points for me to open it. When there is anything she sits with the ear phones just as nice as any large person but as soon as it stops she takes off the phones and starts to scold for more.

"I have six children and they all like to listen. I have two sets of phones and they separate them."

Got Mules by Radio

Recently while in Atlanta on a radio inspection trip, Commissioner Carson of the Department of Commerce, was advised that his best team of mules had disappeared from his farm in a nearby state, and later being in the broadcasting station of a local paper he let the loss be broadcast, with a description.

A few days afterwards when in Nashville, he was advised that his mules had been found wandering miles from home. Whether radio was responsible for their discovery or not cannot be proved, the Commissioner says, but he believes it was instrumental in their release from temporary confinement. "I was glad to get them back," he added, "they were good mules."

Radio Baby

WGY, the Schenectady broadcasting station of the General Electric Company has been honored by a Wisconsin family. A brand new baby, according to the father, has been named after the Schenectady station. He is Wallace Gordon Yadon and he lives in Delavan, Wisconsin. M. E. Yadon, the father, is advertising manager for the Bradley Knitting Company.

Churches Converted

Have you ever wondered how a radio broadcasting station with its fixed equipment manages to send out religious services weekly from churches many miles away from the sending station?

The operating staff of WGY, the Schenectady, N. Y., station of the General Electric Company has so developed church service broadcasting that thousands of letters of appreciation are sent in from far and near.

The installation necessary for broadcasting the services of the Second Presbyterian Church of Amsterdam, N. Y., April 22, is typical and will give the radio fan an idea of how it is accomplished.

In the church were four microphones, two of them spares for emergency use. One microphone and a spare were placed at the reading desk to get the words of the clergyman in scripture reading, prayer, sermon and announcements and a microphone and spare were hung above and in front of the choir and organ. These microphones or pick-ups were the only evidence to the congregation that the service it was hearing was going out to countless thousands many miles away. There is nothing in the church installation to distract the attention of the congregation from the service.

At one side of the church, hidden from view but in a position where he could follow the service, was stationed one of the WGY staff who switched the microphones on and off as the service progressed. If the minister was speaking, his microphone was brought into the circuit and the choir microphone was switched off.

Two other operators were situated in an adjoining room where a portable control equipment had been installed. In this room one of the operators controlled the amplification of speech and music. The amplifying outfit consisted of two 5-watt tubes, one 50-watt tube and other necessary apparatus. Sufficient amplification was used to overcome line noise on the twenty miles of telephone wire necessary to carry the electrical oscillations set up in the microphones to the control room of WGY in Schenectady, N. Y. The second operator in the side room was in constant communication by special land wire with the control room at WGY.

In the control room in Schenectady the church services were again amplified, this time on equipment which consisted of one 5-watt tube and two 50-watt tubes. From this point the electrical oscillations passed to the power apparatus and were impressed on the modulator and oscillator tube going thence to the antenna and the air.

Between church and control apparatus the church service passed through three exchanges of the New York Telephone Company—the Amsterdam exchange, the Schenectady exchange and exchange of the General Electric Company.

Send $1.00 to Radio Age, 500 North Dearborn Street, Chicago, and receive this middle-west radio periodical for six months. Regular subscription price is $2.50 a year.

A New High Speed Code System

By LUTHER M. MEREDITH

EIGHTY years ago Professor Morse, with the invention of his system of electric telegraph, originated a code or alphabet, which from its invention derived the name, Morse code. Various adaptations and changes have been made, resulting in various codes, among them the Continental Morse alphabet, navy and others. The basic principle of all these codes lies in the different time units for dots, dashes and spaces, dashes being three times the length of time duration of a dot with the spaces for words and sentences of a still longer time length than that of a dash. Morse's system, invented before the era of telephone, alternating arc, and radio transmission, during the eighty years since its invention, has outlived its period of utility, the rapid strides in the development of all forms of communication having made necessary various kinds of high speed telegraph systems, none of which have been entirely satisfacrory.

In radio, there are numerous examples of its inefficiency. The present methods of operating large radio telegraph stations, sending, whether accomplished automatically or by hand, has no relation to the nature of the antenna current. The average antenna currents, ranging from two to three hundred amperes are, in the course of transmission interrupted or modified in a manner, long recognized as inefficient, without regard to the point of phase when the transmitting key is opened or closed, and a large flow of current is discontinued or changed whether the nature of the current is positive or negative, at zero or at maximum.

The sudden breaking or changing of a high frequency alternating current results in a group of harmonics being radiated. Bearing in mind that a flow of so great an antenna current, being interrupted in this manner it can be readily understood, that the nature of these harmonics will be of great strength, causing broadened tuning and consequently interference, a problem which is already causing too much disturbance.

The speed rate at which the Morse code can be efficiently recorded, whether by ear or machine is limited, due to the nature of some of the characters of the alphabet being similar, and in order that they may not be incorrectly recorded must be stressed. The characters S and H of this alphabet are good examples of this defect. The letters S . . . and H . . . . require three and four signals of the same sign, and consequently

Gen. George O. Squier

are not as legible as letters such as A . — or — . the letter N. The illegibility of some of the characters in the alphabet as above, retard the speed of the whole alphabet, so the time durations shall correspond. Therefore transmitting costs are higher, than they ordinarily would be, were it that this defect did not exist. Much money and time could have been saved if the code now in use had been designed to meet our original needs. The letter E for instance, the most common letter in English, is composed of the signal . (dot), while the letter O ranging second in importance in the language comprises the signals — — — (three dashes) requiring many more times the duration of the letter E, which of course is quickly recognized as inefficient.

Squier's New System.

Various methods have been invented and tried, but all of them, due to the use of the time durations between letters or characters, have proved inefficient and inadequate. Maj.-Gen. George O. Squier, chief officer of the Army Signal corps, has devised a new system based upon the old code, but with a new basic theory as to the method of transmission. His invention promises to revolutionize the methods of code transmission of radio, telegraph and cable communication.

Briefly, General Squier uses an alternating current, varying the amplification of intensity of each half cycle of alternating current to represent a dot, dash or space. By the use of this system, six different arrangements are possible. To select the most efficient arrangement is the present problem now under way, and it may probably lead to some new heretofore undiscovered arrangements.

In the alternating current system, there are no consecutive signals of the same sign, the difference lying in the different nature of the amplitudes. Therefore the characters being alike in time value, and not in amplitude or sign, will enable their transmission at a speed of 2.65 times faster than heretofore attained in commercial or official radio, telegraph or cable transmission. The advantages of the increase of speed, nearly three times that of any former system, are readily seen.

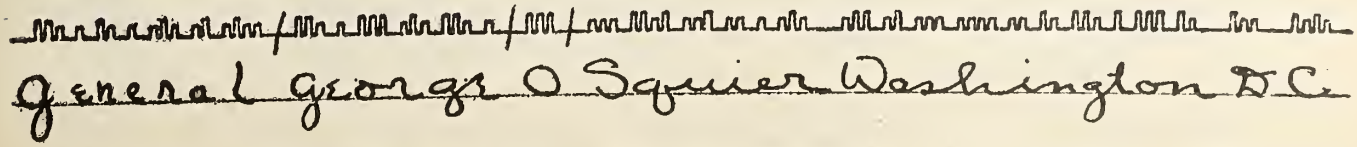
Under the old alphabet, O being composed of three dashes, required eleven units of time, while under Major General Squier's system this all-important letter is transmitted in three units, a decided saving in time, being nearly three times as fast.

The new system promises a method whereby atmospheric disturbances will become a negligible factor in code reception, and with the use of the new system of a modulated alternating current, sharper waves and closer tuning will be possible with decreased interference.

Harmonics will be dispensed with, due to the fact that the current is modulated, and not broken, and the transmission of more traffic between stations who formerly were interfered with by so called pure waves from other stations transmitting, will be more reliable and speedy.

The system is the result of nearly eight years of research and experiment, having its origin in 1915, when a new alphabet for cable communication was being invented.

General Squier again has proven his inventive ability, and the value of his system will doubtless be recognized at the next International Technical Conference on Telegraphy.



Tape record of transmission by Major General Squier's system of high speed telegraphy. This arrangement uses the highest humps for dashes, next highest for dots, the spaces between words and letters having no height.

Pick-Up Records from Our Readers

Stockton, Ill.

Radio Age:

I am a subscriber to your valuable magazine, and would not trade it for any of the other present day radio magazines on the market.

I notice you have a column of PICK-UPS BY READERS, and would like to submit the following list of stations heard with a simple hook-up during three hours and ten minutes of actual listening: KHJ, Los Angeles, Cal., 1650 Miles; WHAS, Louisville, Ky., 366 miles; WJZ, Newark, N. J., 810 miles; WHB, Kansas City, No., 337 miles; WAAP, Wichita, Kans., 503 miles; WWJ, Detroit, Mich., 347 miles; WOC, Davenport, Ia., 50 miles; KYW, Chicago, Ill., 134 miles; WDAP, Chicago, Ill., 134 miles; WLAG, Minneapolis, Minn., 237 miles; KSD, St. Louis, Mo., 250 miles; WOH, Indianapolis, Ind., 260 miles; WOAN, Lawrenceburg, Tenn., 500 miles. WMC, Memphis, Tenn., 493 miles; WSB, Atlanta, Ga., 662 miles; WGM, Atlanta, Ga., 662 miles; WDAJ, College Park, Ga., 665 miles; WWAC, Fort Worth, Tex., 797 miles; WGY, Waco, Tex., 811 miles; WGY, Schenectady, N. Y., 803 miles; WLW, Cincinnati, O., 353 miles; KLZ, Denver, Colo., 819 miles; WCX, Detroit, Mich., 347 miles; KDKA, East Pittsburgh, Pa., 543 miles.

Giving an approximate total of about 12,870 miles for 3 Hours 10 minutes of hard listening, and as an average traveling at about 4,000 miles per hour!

Very truly yours,

JOHN MAHER,

(Note—Mr. Maher's hook-up is shown in Figure 1.)

Escanaba, Mich.

Radio Age:

I recently purchased a copy of Radio Age, and I was startled to find a description of a hookup similar to the one I have been using with very good results.

For my circuit, two variocouplers must be wound. They cannot be purchased, as the windings do not apply to this set. They must be made exactly to the following specifications:

The line variocoupler, or antenna coupler, should have its primary coil wound with 60 turns of No. 20 D C C wire. Start winding 12 turns above the rotor shaft, next leaving a one-half inch space for the rotor shaft, and continue the winding until the entire remaining 48 turns have been wound. Taps should be taken off this coil as follows: Upper 12 turns of coil should be tapped every 4 turns, the remaining 48 turns tapped every 8 turns. The rotor should be wound with 34 turns of No. 22 D C C, 17 turns on each side of the shaft.

The tickler variocoupler should be of the same dimensions, the stator being wound with 26 turns of No. 20 D C C wire with 8 turns above the rotor shaft and 18 turns below it. The primary of this coil is not tapped. The rotor coil is wound the same as that of the antenna coupler. The two couplers must be in inductive relation, not spaced more than six inches apart. Connections are made as in Figure 2.

This instrument has the loudest regeneration up to the distortion point of any set I have ever operated. It brings in stations on any average antenna from all parts of the country. Chicago stations have been heard using a bed spring as an antenna. At times I use no antenna at all for local stations.

Very truly yours,

A. J. BAUMGARDNER,

(Note: This circuit is very similar

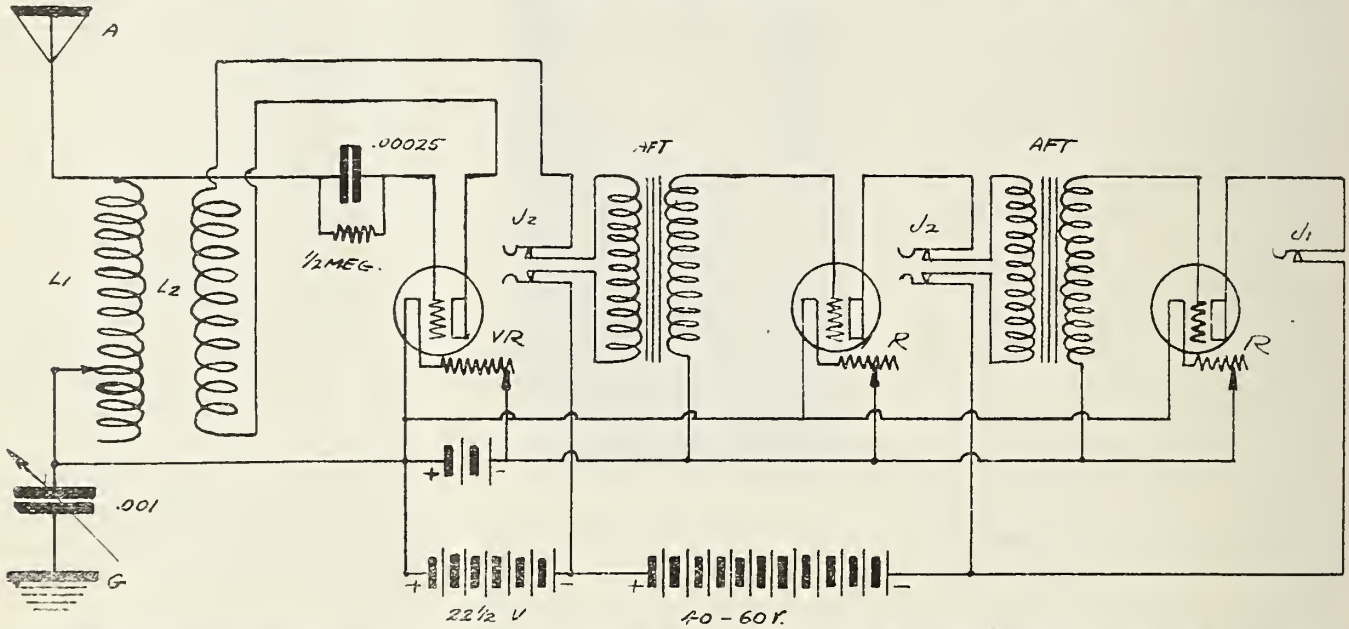


Figure 1. A hookup which many of our readers are using with great success. L1 and L2 are the primary and secondary of a variocoupler. The condenser in the ground lead is a 43 plate. J1 is a single circuit jack, while J2 are double circuit jacks. AFT, audio frequency transformer.

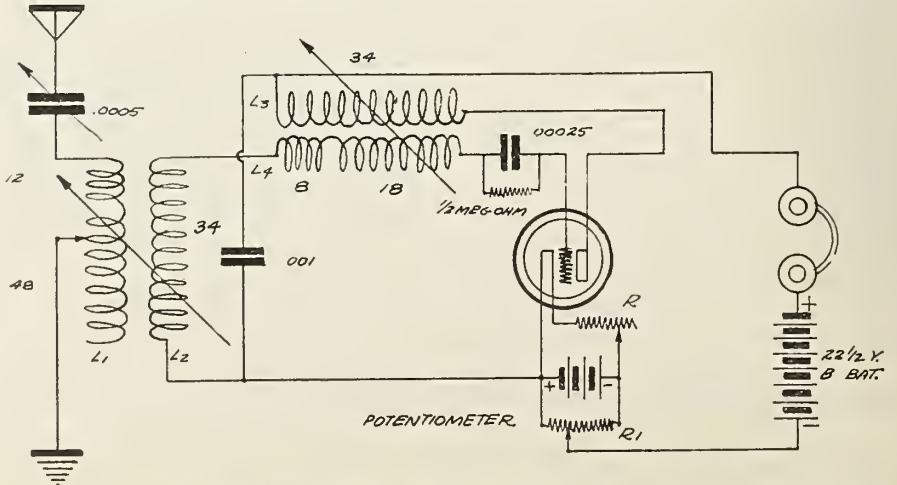


Figure 2. Mr. Baumgardner's Circuit. L1, 2, 3, and 4 are the primaries and secondaries of rewound variocouplers. The antenna condenser is a 23 plate. The condenser shown across the plate and grid return circuits, should be a .001 fixed telephone condenser.

Pick-up Records from Our Readers

to the circuit published in our April issue, of the one tube antenna set by Mr. Raymond Chessevent.—The Editor.)

In our April number we published a communication from one of our readers, Mr. John A. Barnes, 5911 MacPherson Ave., St. Louis, Mo., containing account of stations received on a two slide, one tube set with a one wire antenna. Mr. Barnes now writes:

"I have received so many requests for the hookup of my set I wrote you about that I am sending it to you hoping it may be of some service to your readers."

Mr. Barnes' circuit appears in Figure 3.

Mr. Paul G. Smyth writes:

"I am enclosing herewith a diagram of a circuit which can be made into an ideal portable set, so that it may be transported for summer use. This set was used in a suit case, with a loop antenna one and one-half feet across, and fine results were obtained from local stations. On a regular antenna stations as far as Denver, Colorado, have been received. KYW of Chicago came in at several intervals with loud-speaker intensity."

Considering that Mr. Smyth lives in Brookline, Mass., his circuit must be a good one. His connections are made as in Figure 4.

"I have built a radio set as described and have found it very satisfactory. Am receiving WGY and WEAF as clear and loud as any Chicago stations. Also received WOC, WDAF and WLAP all with one detector tube.

"This set of mine is the laughing stock of the neighborhood because I have it built in a small wooden store box."

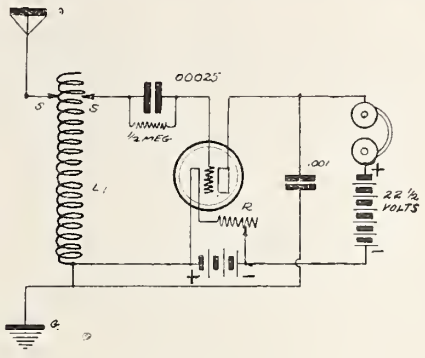


Figure 3. This circuit utilizes a tuning coil L 1, with S as the two sliders. A vernier rheostat should be used in this circuit, as the filament control is a big factor in the tuning of the set.

Here's a Hook-Up

Conrad Herchem, 1729 Galena Street, Milwaukee, Wis., writes:

"I experimented on a hook-up for a crystal set and I got such good results that I wish you would publish this in your magazine so that others may have the same fun as I have had. The hook-up is as follows: The winding is on a paper tube four inches in diameter and ten inches long, the main winding is of No. 26 dc wire. Eight taps are taken off; the first tap after five turns the second after ten turns; the third after fifteen turns, fourth after twenty turns, etc. The tickle coil is of No. 26 also. The windinsgÿi fty turns on half."

Summer Park Concerts

Although the broadcasting of the Government's band concerts by NAA, Arlington, will cease during the summer months, radio fans within several hundred miles of Washington will be able to pick up some concerts if the plans of the Chesapeake & Potomac Telephone Company are carried out.

By June 15, this company now hopes to complete its new station in Washington and start broadcasting the open air public concerts from the White Lot and local parks where the Marine, Navy and Army bands will play almost daily

Through the aid of a new portable "input apparatus" recently perfected by the telephone engineers, the Chesapeake and Potomac company expects to furnish the added juice necessary to pick up concerts and transmit them by wire to their station for radio broadcasting. This apparatus is mounted on a motor truck and can be dispatched anywhere in the city where something is to be broadcast.

Representatives of the company say that it is sometimes difficult to relay speeches and music from private residences via telephone lines to broadcasting stations due to lack of current, but with the new booster they expect to overcome this handicap.

Important speeches and concerts also will be put on a land line to New York and broadcast simultaneously from WEAF on a different wave length, telephone officials state.

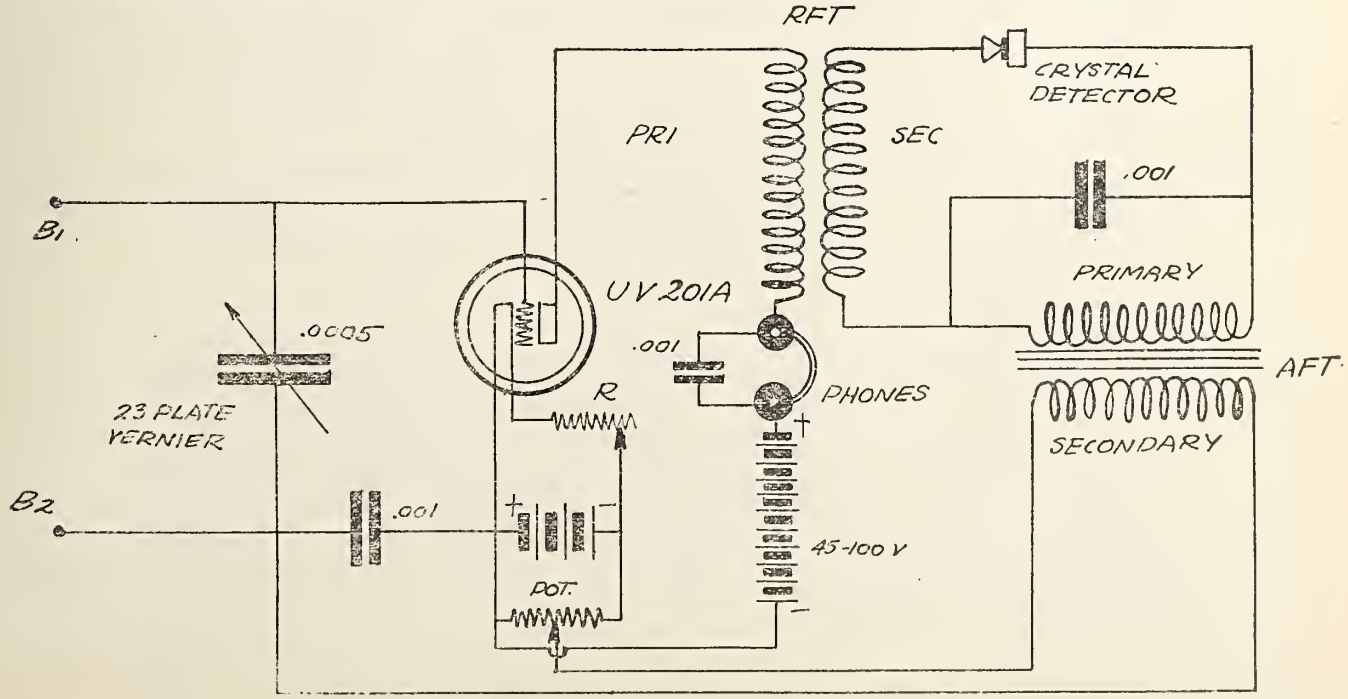


Figure 4. A one tube reflex circuit with which one of our readers says he is getting long distance stations. Either a loop antenna or regular antenna may be used on this set. If a regular aerial is used, a variocoupler secondary should be connected to B1 and B2. Otherwise the loop is connected to the same posts. RFT is a radio frequency transformer, while AFT is an audio frequency transformer of a 10 to 1 ratio.

Passing of WJZ

Already radio is old enough to have its traditions and its memories of past glories. Old WJZ, the Newark station, which made the bedtime story famous, and was one of the pioneer stations to assist in putting radio on the map in the United States, is no more.

On May 15 the station, which was operated by the Radio Corporation of America and the Westinghouse Electric & Manufacturing Company, was closed. Only the old familiar call signal was retained. Hereafter WJZ will mean the call of the Broadcast Central station whose lofty aerials are atop the Aeolian building, Fifth avenue and Forty-second street, New York City.

Broadcast Central, the new radio station of the Radio Corporation of America, which has been the subject of considerable speculation among radio listeners who have heard the station testing with call 2XR, was opened May 15.

Located in the heart of the city's musical and theatrical district, where entertainment of the highest order is ever available, this station offers to the American public elaborate programs with a degree of faithfulness in reproduction that marks the beginning of a new era in radio broadcasting. The wires which tower 400 feet above the street on Aeolian Hall, at Fifth Avenue and 42nd Street, provide two antennas, and this superstation will transmit two broadcast programs simultaneously, on different wave lengths.

The closing of station "WJZ" at Newark coincided with the opening of Broadcast Central. The well-known call "WJZ" was retained for transmission from the Aeolian Hall station on 455 meters while the call "WJY" is used for the other wave length of 405 meters, both of which wave lengths have recently been allocated to the new station.

The new station is fitted with a double antenna and two independent transmitters which permit a dual program to be broadcast, one, that of classical or serious entertainment; the other, popular airs, dance music and lectures.

The Radio Corporation of America has made a thorough analysis of the types of programs best suited to the requirements of the public and this study has revealed the fact that generally, the radio public may be divided into two classes, those who prefer classical or similar entertainment and those desiring dance music and popular airs.

Not only will transmission be carried on from the two studios which are a part of the station, but the main recital hall of Aeolian Hall has been connected to a switchboard in the station thus providing at frequent intervals another source of the finest music obtainable.

To guard against interruption in programs, two spare transmitters are installed together with the necessary controlling apparatus which will enable the operator to make an instantaneous change from one set to another should any trouble develop.

Broadcast Central is a model station both in electrical design and operating facilities incorporating the most advanced ideas of RCA engineers. One of the outstanding improvements is the "checking up" of the broadcast programs for clearness in transmission. This is accomplished by a "moving picture" device connected with the antenna which shows at a glance the perfection in reproduction of music or voice as the radio waves leave the antenna. Any distortion occurring during a rendition may be instantly corrected by the operator who watches the electrical vibrations as they radiate into space.

Class B Calls and Waves

Thirty-four Class B stations, each with a territorial zone, have been licensed by the Department of Commerce to start operating on May 15.

The zone waves originally designated for Seattle and Portland have been transferred; Seattle has been assigned the 455 meter wave on 660 kilocycles, and Portland, 492 meters, or 610 kilocycles.

A special wave for Class B stations in Madison, Wis., and vicinity may be designated as 345 meters if a station qualifies.

Specific B Waves by Stations

The calls and waves for thirty-four Class B stations follow:

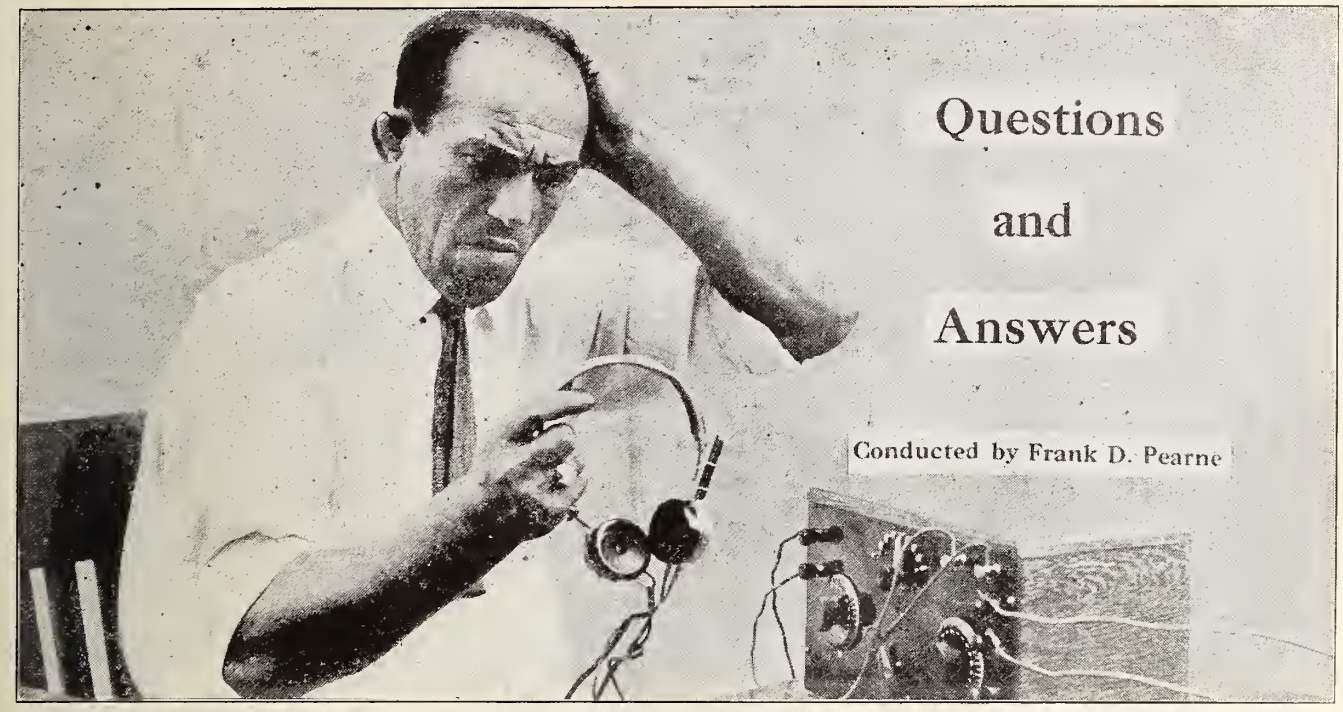
	Call	Wave
California:		
Los Angeles, Earle C. Anthony	KFI	(395 or 469)
Los Angeles Times-Mirror	KHJ	(395 or 469)
San Francisco, Hale Bros. Inc.	KPO	(509 or 423)
San Francisco, Mercantile Trust Co.	KFDB	509
Georgia:		
Atlanta, Constitution	WGN	429
Atlanta, Journal	WSB	429
Illinois:		
Chicago, Westinghouse Elec. & Mfg. Co.	KYW	345
Chicago, Daily News	WMAQ	448
Iowa:		
Davenport, Palmer School of Chiropractic	WOC	484
Kentucky:		
Louisville-Courier Journal and Times	WHAS	400
Massachusetts:		
Springfield, Westinghouse Elec. & Mfg. Co.	WBZ	(337)
Michigan:		
Detroit, Free Press	WCX	517
Detroit, News	WWJ	517
Minnesota:		
Minneapolis, Cutting & Washington Radio Corp.	WLAG	417
Missouri:		
Kansas City Star	WDAF	411
Sweeney School Co.	WHB	411
St. Louis, Post Dispatch	KSD	546
New Jersey:		
Newark, Bamberger & Co.	WOR	405
New York:		
New York, American Tel. & Tel. Co.	WBAY	492
New York, Western Electric Co.	WEAF	492
New York, Radio Corporation	WJY	405
New York, Radio Corporation	WJZ	455
Schenectady, General Electric Co.	WGY	(380)
Troy, Rennselaer Polytechnic Inst.	WHAZ	(380)
Oregon:		
Portland, Oregonian	KGW	(492)
Ohio:		
Cincinnati, U. S. Playing Card Co.	WSAI	309
Pennsylvania:		
Philadelphia, Gimbel Bros.	WIP	509
Philadelphia, Lit Bros.	WDAR	(395)
Philadelphia, Strawbridge & Clothier	WFI	395
Philadelphia, Wanamaker	WOO	509
Pittsburgh, Kaufmann & Baer Co.	WCAE	(?)
Tennessee:		
Memphis, Commercial	WMC	500
Texas:		
Dallas, News & Journal	WFAA	476
Fort Worth, Star Telegram	WBAP	476

Stations with waves in parentheses are not definitely assigned.

New Wave for NAA

Since May 10, Arlington NAA has been broadcasting governmental information on the 435 meter wave instead of 710. This change was made in connection with the Department of Commerce's new schedule.

Talks on the standard radio frequency signals, being transmitted by the Bureau of Standards from time to time from WWV, are an added feature of the Commerce Department's broadcasting schedule from NAA, Tuesdday evenings be-



The technical department sends out many replies to questions in each day's mail. This service heretofore has been free to all but in order to assure this service to our subscribers this direct reply method hereafter must be restricted to those fans who are on our subscription list.

Fans who are not subscribers may obtain this service by enclosing 50 cents with their question and the reply will be mailed at once, accompanied by circuit diagram where illustration is needed.

All inquiries should be accompanied by self-addressed and stamped envelope.

E. T. S., Chicago, Ill.

Question: I made the WD 11 tube circuit of the March issue, and it works beautifully, in fact I get stations from all parts of the country. Now I want to build a two stage amplifier, using W D 11 tubes for amplifiers, in this set. What transformers must I use on the first and second stages? Please explain primary and secondary windings on the transformers. Must I use vernier rheostats in the amplyfying circuits? I burned out two W D 11 tubes although the filament showed a faint red, when my rheostats were turned about half way up. What is wrong?

Answer: In Figure 1, I am printing a diagram of the circuit you speak of in connection with a two step amplifier, using W D 11 tubes. Carefully note the manner of connections on the dry cells which are connected up in parallel to give the required amperage for the W D 11 tubes when used as amplifiers. For the first stage use a 10 to 1 ratio transformer, and on the second a 5 to 1 or 3 to 1 ratio. Transformers are usually marked P and B+ for primary connections, and G (grid) and F— (filament Negative) for secondary connections. You will not need vernier rheostats in the amplyfing circuits. The reason you burned out your tubes was probably due to either a shorted connection or an excessively strong battery. Would advise that you look back into the May issue of the Radio Age, and learn how to protect your tubes with fuses.

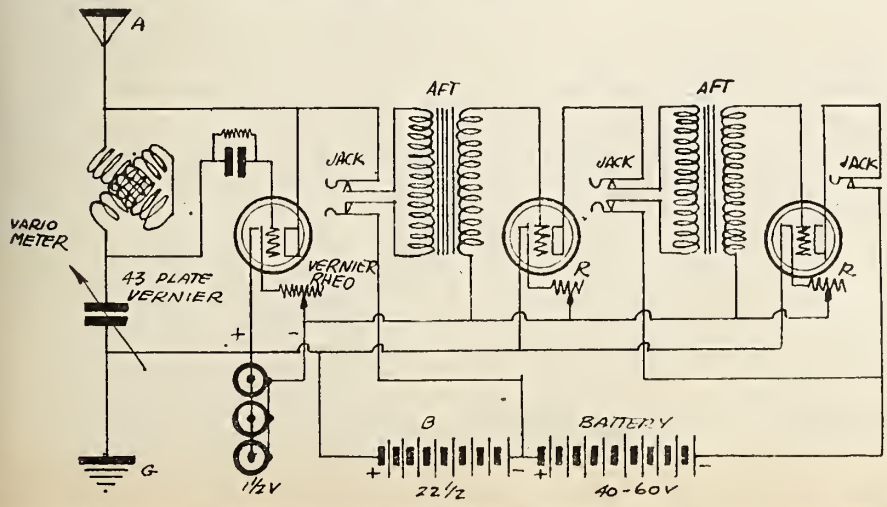


Figure 1. Using WD 11 tubes for amplifiers on the single variometer circuit. Note the connections on the dry cells which give the necessary extra amperage when more than

L. H. P., Kansas City, Mo.

Question: I would like to obtain a hook-up for a crystal set that would receive from 75 to 100 miles. If there is such a hookup will you please print it?

Answer: I am showing in Figure 2 a hookup which has been giving unusual results over greater distances than which you ask for. Tuning is exceptionally fine, which is accomplished with the variometer shown in the circuit. It will no doubt satisfy any crystal BCL.

J. H. H., Cameron, Mo.

Question: Please publish a diagram of the Kopprasch circuit. I have heard that it is giving very good results. Can it be used with a W D 11 tube?

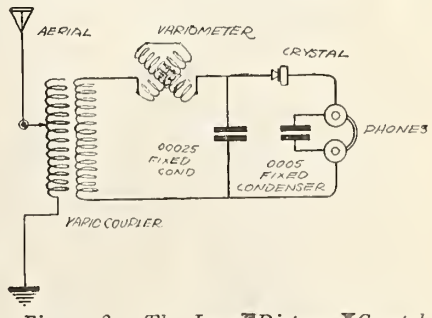


Figure 2. The Long Distance Crystal Hookup, which is giving very good results over extremely long distances. Tuning is accomplished with the variocoupler and variometer shown in the circuit.

Answer: The Kopprasch circuit and the details of construction appeared in the April number of Radio Age. However, I am enclosing herewith a diagram of the circuit in question. It is giving very good results in connection with the

Questions and Answers—Continued

I. W. F., Chicago, Ill.

Question: I would like to change my loose coupler crystal receiving set into a one tube set. Please send me a drawing showing how this is done.

Answer: Figure 3 will show you how to properly connect your former crystal set to a tube and increase your range.

E. J. P., Memphis, Tenn.

Question: I am constructing the two circuit crystal detector receiving set on pages 6 to 10 of the April number of Radio Age. Now everything has been made very plain in the instructions with the exception of coil tube P. Shall I begin winding the wire in the same direction as on coil tube S? Please send me full instructions on how to wire up this coil, as I am very much interested in this set.

Answer: The primary coil P is constructed as follows: On a cardboard tube 4 1-4 inches in diameter and 5 inches long wind 90 turns of number 22 wire. Tap the first 10 turns every single tap, thereafter tapping only every 10th turn, until the winding is complete with 90 turns. The taps are brought out to switch points and soldered. Two switches are connected to the antenna and ground respectively, the switches making contact with the switchpoints. The wire on this coil should be wound in the same direction as on the coil S.

E. P., Dallas, Texas.

Question: I have a few questions that I would like to ask you. I want to put one step of audio and one step of radio frequency amplification to my present set which consists of two variometer, vario-coupler and variable condenser in the aerial circuit. Do you think it a good plan? If so, please send me a complete hook-up of the circuit. Why is it, that the Chicago stations are not picked up in this city very frequently? I have had my set for about six months and only rarely do I pick up Chicago stations. How come? I hear WOC, WWJ, WLAG, and others quite frequently.

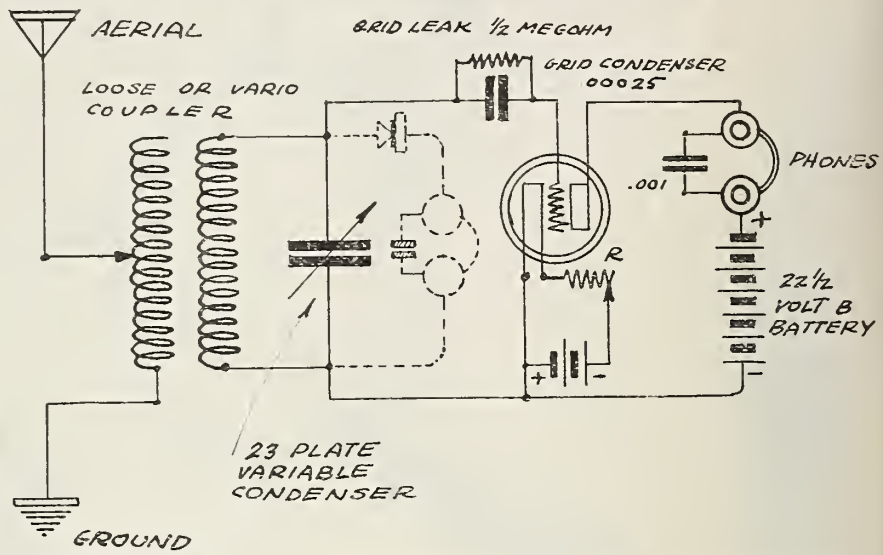


Figure 3. A two circuit crystal hookup can be remodeled into a one tube set with the few simple changes as indicated in the circuit diagram.

Answer: Figure 4, shows you how to correctly connect up your present apparatus with one step of radio frequency amplification. To do this, you will not need a grid variometer, the tuning of this part of the circuit being done with a 23 plate condenser. A 3 plate vernier condenser connected across the primary of the RF transformer will help in tuning. The probable reason you do not hear Chicago stations is that your location is not favorable to reception from this region.

A. E. C., Washington, D. C.

Question: I recently hooked up the Kopprasch Circuit described in the April issue of RADIO AGE, but have been unsuccessful in bringing anything in. Perhaps I do not know how to tune it, or it may be some other trouble. I tuned as follows: Plate varimeter at maximum (windings parallel), turned condenser until a hissing was heard, then grid variometer, following this procedure on each tap. The hissing increased by adjusting the grid variometer until suddenly a deafening screech resulted but nothing more, though I readjusted the plate variometer and also the other dials. At several points on the condenser a knock or click resulted in the phones, but adjustment of variometers merely changed this to a hiss or screech. What can you suggest?

Answer: The probable causes for poor results with the Kopprasch circuit which you have constructed might be traced to an improperly adjusted grid leak or probably too high a plate battery potential. Would suggest that you procure a tapped plate battery and try reducing the voltage until the set spills over very gently. After this has been done adjust the grid leak until the signal is clearest. The noise you write of, might also be caused by a poorly made connection, so I would advise that you go over the set and make sure that no descrepancy in wiring exists. The best way to tune is to set the plate variometer and the condenser of the set until it oscilates slightly, and then tune around with the taps and grid variometer until a signal is heard. Smooth out with the plate variometer and condenser, until the signal is loudest and clearest.

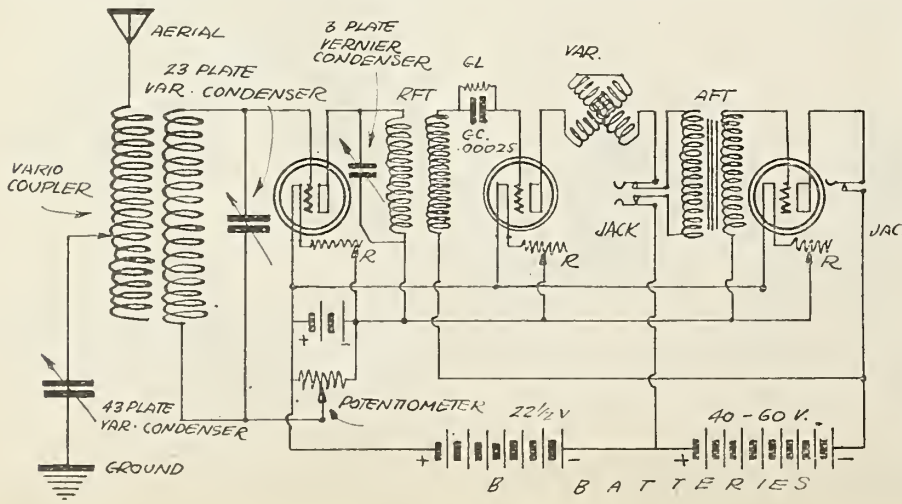
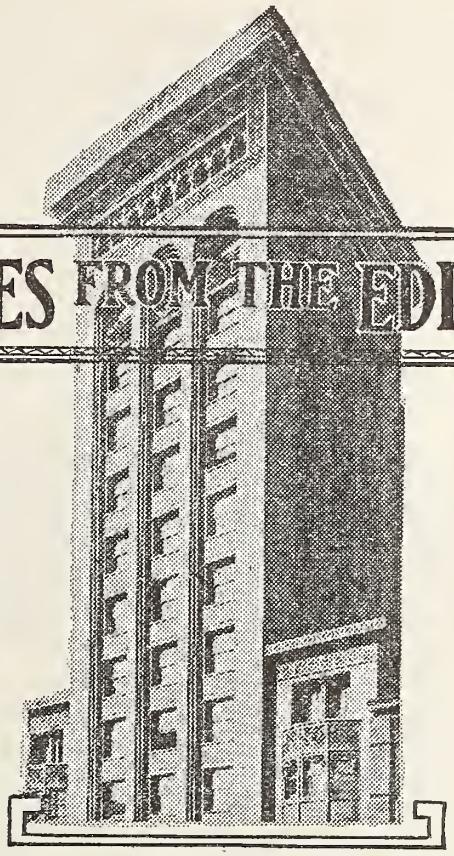


Figure 4. In the Three Circuit Regenerative set, the grid variometer is omitted when radio frequency amplification is added, and the tuning is accomplished with a 23 plate vernier condenser across the secondary of the variocoupler.

An English radio enthusiast who thinks nothing of sitting up until 4 o'clock in the morning to get American broadcasting stations, reports receiving the entire program of WGY, the Schenectady, N. Y., station of the General Electric Company, on four different evenings. The most remarkable feature was his reception on a single tube or valve—as the English call them—homemade receiving set. He is J. H. Brittain and he lives at Eccles, Lancashire, England.



THOUGHT WAVES FROM THE EDITORIAL TOWER

WENDELL Hall, song writer and singer, recently has proved that radio can make a song hit. The American Society of Composers, Authors and Publishers, contends that radio does not create a demand for the songs and musical compositions copyrighted by the society but rather diminishes the demand for such songs and musical numbers.

Whether that be true, and whether the accompanying demand made by the authors and composers that a tax be paid for use of copyright music be justified, Mr. Hall has recently put over a great seller through the singing of his own song "Mellow Moon" from Station KYW, Chicago.

It is another contention of the authors and composers that persistent broadcasting of feature numbers from theatrical productions results in diminished box office receipts at the theaters where those numbers are being produced. This contention also appears to be answered by the fact that grand opera was broadcast throughout the 1922-23 season and that the season's receipts at the Chicago auditorium showed a material increase over those of the preceding season.

SEVERAL months ago Radio Age published an article calling attention to the fact that the necessary use of storage batteries in connection with radio receiving sets made it difficult for the man on the farm to keep his set going. Necessity for recharging of batteries, without facilities of electric light wiring, forced the farmer to carry his batteries to town or possibly to attempt to use batteries removed for the purpose from his automobile.

It was a difficulty that seriously impeded the popular growth of radio in the rural districts. At the time the article was written there seemed no way out of the difficulty.

But now, with the agile way radio has of leaping over obstacles, the engineers have designed sets equipped with tubes which may be efficiently operated with dry batteries, which do not have to be recharged and which are much smaller and lighter than the cumbersome and untidy storage battery.

It only goes to show that radio is irresistible. There is to be steady progress, let the obstacles be what they may. It is the farmer's chance to get in on the entertainment and news bulletin service that has delighted millions in the towns and cities.

SOME newspapers, otherwise progressive and alert, persistently remain aloof from radio. Several reasons may be assigned for this. One of them is that the publishers and editors of those newspapers are unfamiliar with radio. The same sort of editors and publishers remained aloof while the phonograph was taking the place of the old mechanical music box. The same editors and publishers were skeptical about the automobile as a practical means of conveyance. The same editors and publishers were sure that the moving picture was either a passing toy or a basis of stock promotion schemes.

Now, with their advertising columns filled with automobile, moving picture and phonograph advertisements some of them still are waiting to see whether this radio thing is not a dangerous innovation. They perhaps wonder whether it would not be best to be off with the old love before they are on with the new.

The newspaper editors and publishers who have given space to radio departments and who have actually established broadcasting stations as a part of their newspaper service are reaping the benefits of their competitors' indecision.

Many newspapers appear to figure that if radio broadcasting from their own station would not increase their circulation, or even their direct advertising, that such a station would be an extravagant incumbrance

We want to ask the editors and publishers of newspapers a question:

When the millions of radio fans listen daily to programs from St. Louis, for example, do those fans not eventually associate a city with the name of a newspaper that broadcasts the programs? Among those millions of fans are there not thousands of individuals who are directly or indirectly associated with the business of advertising nationally? Would it not be the inclination of those individuals to take it for granted, in placing such national advertising, that the newspaper that had been making the entire country listen to its radio programs, probably would make the best advertising medium in the particular city in which the broadcasting newspaper was located?

We grant readily that such a broadcasting newspaper might not be at all the best advertising medium in its city but would not there be a country-wide impression that it was the best medium and after a sufficiently long period had elapsed might not this impression actually result in making that newspaper the best medium?

We don't know. So we ask.

Radio on the Farm?—Let These Farmers Tell You

Appreciation of the entertainment brought to the farmhouse by radio is expressed by Peter C. Swartz in a recent number of The Wisconsin Agriculturist. Radio eventually will find its best friends of all on the American farms. Already it is taking hold. Read what Mr. Swartz has to say:

Radio and Wireless!

How common these words get when one has a radio machine, and other words also become common and very familiar, such as antenna or aerial wire, insulators, variocouplers, variable condensers, tuning coil, detector and amplifier tubes, receiving head sets, magnavox or loud speaker, "A" and "B" batteries, etc.

At first one wonders if he will ever learn how to run or operate or install a radio outfit, but that wears off readily if you have some one who has some experience when you install. It took less than three hours to install ours. We just put a baled hay wire around the cupola of one of the barns and another around the chimney of the house, and stretched our copper antenna wire from these baled hay wires, grounded the radio machine to the water pipes, connected the "A" and "B" batteries and then tuned in the machine.

Behold, there was the voice of a man talking from Madison, and when he finished they announced the next would be music by a band.

"You can't fool me," the hired girl said, "pretending that you heard a man talk and now hear music with that little contraption, and the little wire you put up." In the next twenty seconds she lost her bet.

Radio has come to stay forever. It's a godsend to us farmers. No matter how far from the city we live or what city is nearest you, radio connects you to cities thousands of miles away. It's almost unbelievable how fast wireless with electricity works when it carries the human voice or music 186,000 miles per second or nearly seven and one-half times around the world in just one second.

Five Preachers in a Box.

It comes faster than a flash, hits our antenna wire and the radio machine transforms and amplifies the original words or music. It does even greater things than that. Sunday evening, March 25, 1923, our machine had five different ministers cooped up in it at one time from five different cities. If we did not like one we tuned him out and tuned in another.

Yes, can you imagine that the radio machine you see in the picture gave us a sermon from a minister in Schenectady, New York, and in a second with a slight turn of the variable condenser we heard the minister preaching in Davenport, Iowa. This is given just as an example. It was storming, snowing and blowing and cold outside, hard and disagreeable to go to church for many on such nights; and then you only hear one minister, while the radio gave us five and we could have our choice right at home where it was warm.

Markets Immediately.

The air is now full of radio. You cannot see it. You cannot hear it. You cannot feel it. Yet it is sent out and is in the air everywhere. With a radio machine it's all yours, free of charge. We have listened to concerts that would cost $3.00 a seat but at home with the radio cost us nothing. We just picked them out of the air.

Live stock is sold in Chicago. A few minutes later we hear what they brought also how many cars of each and all the news around the yards.

The price of all the grains at the board of trade, vegetable markets of all kinds, everything on the commission row, even the price of sugar, and prices of all the different kinds of hay, weather forecast, latest news and many other things can be picked out of the air.

Radio gives us these markets and weather reports nearly twenty-four hours before our daily papers get them to us. We know more about our farming business than ever before. We are right in touch with the markets, weather, and outside world. Radio on the farm is really a godsend.

It has come to stay. It will keep thousands and thousands of girls and boys on the farm. It gives them the music, songs and talks of the bright lights in the city, and they can have their choice. Every night the air is full. Dixie land. My those darkies are spicey. The hundreds of talks and news given out over radio are short, snappy and very educational on hundreds of subjects.

You may ask what is the limit in distance of hearing things over a radio in Wisconsin. It's anywhere in the United States and parts of Canada. I'll prophesy they'll have radio machines for us farmers in the future so we can hear anything sent out anywhere over the world.

Ted Roush, of Highland County, O., also is a booster of farm radio. Read what he says in the following, published in Crosley's Weekly:

"We have had a radio in our home just one year. As farmers we would like to give our experience for the benefit of our brother farmers, who might not own one as yet, but who are somewhat interested.

"A year ago, after becoming interested in radio we decided to make our own set and were very successful.

"At first we made a detector set only, but later put on two stages of amplification and a horn. We can truthfully say, after one year, that we would not exchange our wireless set for the most expensive phonograph on the market, and by this I do not mean to run down the phonograph.

"Of course, at first we were much excited over our radio and listened to concerts, markets, sermons, lectures, etc., half of the night. But after the newness wore off, we just watched the programs and listened to the best of what we wanted.

Daily Programs.

"Now we go on at 10 o'clock every morning and get the markets and weather report; then at 12:30 again we hear the daily news flashes. If we want to get markets later, we can get them at one o'clock. There is hardly an hour during the day but what there is something going on, such as music, lectures, baseball and football reports. Any one interested in these games can hear them as played, i. e., they will tell how each player is working, what the excitement is and everything that transpires.

"During the harvest season we depended quite a bit on the weather fore cast. We did not get any hay wet and were very successful with our harvest, never cutting down with the promise of rain.

"At one time a neighbor called me on the phone and asked about the weather for the following day, and we informed him it was likely to rain. That night we got a heavy rainfall. On seeing him a few days later he said that he had hay down and did not know whether to cut down more or put up what he had

(*Continued on page* 26)

NATIONAL BROADCASTERS' LEAGUE,
500 North Dearborn Street, Chicago, Ill.

Gentlemen: As an owner of a receiving set I am personally interested in the effort now being made by your organization to provide the best popular music for broadcasting.

I appreciate the fact that the broadcasting station owners have been giving me free for one year an entertainment service that has delighted myself and millions of other owners of receiving sets.

I want you to know that I regard it as a privilege, rather than an obligation, to say to you that I stand ready to give you my support in your plan to restore popular music to all stations included in the League.

How can I be of assistance?

Yours truly,

Name.....

Street number.....

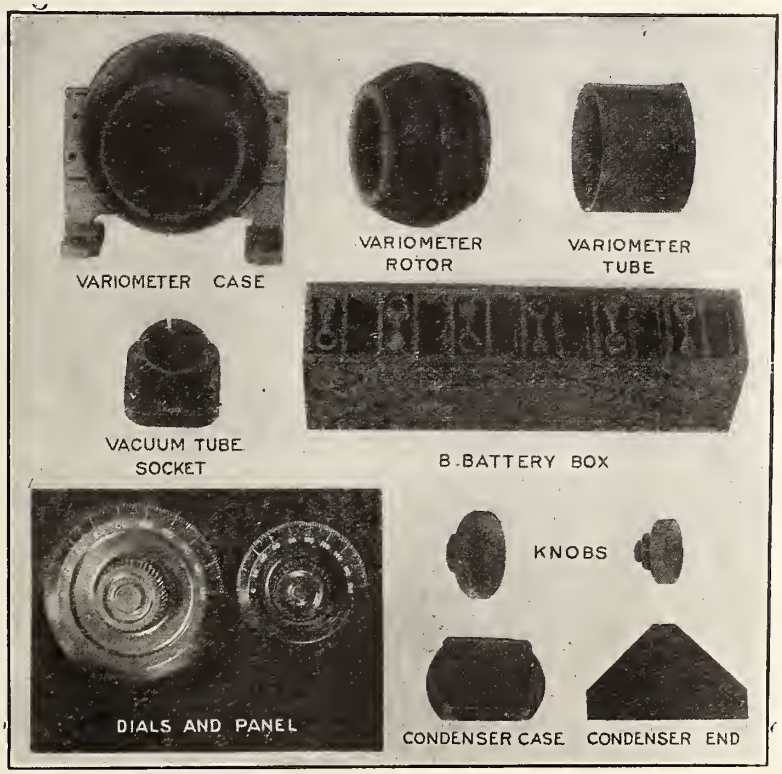
City.....State.....

Use of Rubber for Radio Parts

THE unprecedented demand for radio instruments is indicated by statistics which show that during the past year the number of broadcasting stations increased from 80 to 581. The number of receiving instruments—in operation within a radius of 100 miles of New York City alone is said to be 500,000, serving a nightly radio audience of more than 2,000,000.

Radio experts are beginning to question the reliability of electrical characteristics based only upon direct current or comparatively low frequency alternating current measurements. Electrical tests made at the tremendously high frequencies of the average broadcast carrier wave require extremely sensitive instruments involving the use of insulating materials which permit the smallest possible electrical losses.

In the recent stage of development the tendency in construction of radio receiving instruments is improvement in quality and elimination of mere cheapness of part. Radio instrument building is stabilizing on quality, and therefore consideration is being given to the special dielectric characteristics of hard rubber as an insulating material of the best sets.



The superior insulating qualities of radio instrument parts was undisputed for years in the development of wireless communication. It still remains unsurpassed as an insulating material by any of the hard molded plastic compositions, the use of which in molded parts became enormous during the unprecedented rise of radio in popular interest. The principal reason for this seems to be the facility with which the phenolic resin compounds can be molded in highly finished pieces with or without metal inserts. Volume production, rather than absolute superiority of dielectric quality, is naturally the controlling factor from a manufacturing standpoint.

Radio Panels

Some hard rubber compounds are more suitable than others for radio insulations. In general, hard rubber compounds possess in a high degree those characteristics most necessary for insulating materials employed in making radio panels and such molded parts as dials, knobs, sockets, insulators, etc.

It is well known that high frequency currents are difficult to control, and consequently radio receiving apparatus is best when designed and made of materials which permit the smallest possible electrical losses.

Radio engineers have determined that there are four most important characteristics to be considered in panel or other insulating material. These are phase angle difference, dielectric constant resistivity, both volume and surface, and the tendency to absorb moisture.

Phase Difference

Phase difference is a property which expresses the heating of the material and at radio frequency largely determines the radio frequency voltages the material will stand without injury and power loss in insulating parts. It introduces resistance in the circuit and diminishes selectivity. The phase difference should be the lowest possible.

Dielectric Constant

Dielectric constant is an important factor in the material used in making the condenser. It determines the amount of alternating current which flows when an alternating voltage is impressed on the condenser. It also helps in determining how much the condenser heats and the high frequency voltage at which the insulating material is injured.

Resistivity.

Surface and volume resistivity determine the resistance to the passage of an electric current across the surface or through the insulation. The higher the resistivity the better the insulation.

Absorption of Moisture

Absorption of moisture has a most important effect on many of the electrical properties of the material, especially on phase difference and resistivity. Insulating material should therefore absorb no moisture and have a high surface finish to produce the best results throughout all seasons and in climates where humidity is a serious factor.

A hard rubber compound best suited for radio use, besides possessing these necessary electrical characteristics, must be nonporous, non-absorbent, permanent, easily, quickly and accurately molded and machined with ordinary tools without danger of chipping. It must also be low in free sulphur content, and the sulphur must be fixed in the compound so that it will not come to the surface or "bloom."

One of the most successful special compositions of hard rubber designed for radio panels is known as Radion. This material is produced with satin-like finish in black, brown and in a skilful representation of the grain of mahogany. This material ranks high in the four most important requirements for radio insulations.

The authoritative tests of Radion are as follows:

1. Low Phase Angle Difference.....0.5 to 0.6
2. Low Dielectric Constant.....3.9
3. High Resistivity (Megohms-cm).....1.0 x 10.8
4. Low Absorption of Moisture—
   In Air.....005% to .02%
   In Water.....08% to .11%

The results show phase difference of ½ dielectric constant of ½ and absorption of moisture of 1-14 of the same characteristics for phenolic and laminated phenolic materials.

It is interesting to note that hard rubber sheet in the form of panels is practically only half the price of panels made of the various phenolic resin compositions either pure or composite. The reason is that in sheet form hard rubber is vulcanized in very large volume at each curing, therefore notwithstanding the fact that the time of vulcanizing may be several hours, the labor cost of the output is low considered either on a weight or volume basis.

The advantages of employing only the best insulating material in the construction of radio instrument parts is shown in the following quotation from a leading radio engineer:

"Current leakage between binding posts or other mounted metalic parts of

(*Continued on page 30*)

Symbols Used in Radio Age Diagrams

CROSSED WIRES, NOT JOINED

JOINED WIRES

RESISTOR

RESISTOR, VARIABLE

INDUCTOR

INDUCTOR-VARIABLE

INDUCTOR ADJUSTABLE

INDUCTOR, IRON CORE

MUTUAL INDUCTANCE, OR INDUCTIVE COUPLER

INDUCTIVE COUPLER, WITH VARIABLE COUPLING

TRANSFORMER

BATTERY
LONG LINE, POSITIVE ELECTRODE
SHORT LINE, NEGATIVE ELECTRODE

VOLTAGE DIVIDER

GROUND

CONDENSER
AUDIO-FREQUENCY

CONDENSER
RADIO-FREQUENCY

CONDENSER, VARIABLE

AMMETER

VOLTMETER

GALVANOMETER

CRYSTAL DETECTOR

ELECTRON TUBE
(THREE-ELECTRODE)

TELEPHONE RECEIVER

TELEPHONE TRANSMITTER
(MICROPHONE)

BUZZER

SPARK GAP, PLAIN

ANTENNA, CONDENSER OR OPEN TYPE

COIL ANTENNA

KEY

SINGLE POLE, SINGLE THROW KNIFE SWITCH

SINGLE POLE, DOUBLE THROW KNIFE SWITCH

DOUBLE POLE, SINGLE THROW KNIFE SWITCH

DOUBLE POLE, DOUBLE THROW KNIFE SWITCH

TRIPLE POLE, SINGLE THROW KNIFE SWITCH

TRIPLE POLE, DOUBLE THROW KNIFE SWITCH

REVERSING SWITCH

An Army in Field Depends Upon Radio

By CARL H. BUTMAN

WASHINGTON, D. C.—Efficient communication in the Army is coming more and more to depend upon radio, and in order to keep abreast of its rapid development, the Signal Corps of the U. S. Army maintains a complete radio research laboratory at Camp Alfred Vail, N. J. At this modern laboratory, the development of new and special apparatus for the several arms of the service is planned and perfected. A number of America's foremost radio engineers there are engaged upon radio problems. A radio school for military students is also conducted at Camp Vail, where men from the different corps are trained as experts.

Functions of the Signal Corps do not comprise radio communication solely, but include all means of signaling running from visual, through the pigeon service, line telegraphy, cables, telephone work including field service to the latest methods of radio communication. The Signal Corps also includes a meteorological and electric time services.

In the time of war, a Signal Officer pointed out recently, victory or defeat has sometimes hung upon the transmission of a single message, and the importance of communication is so great that no engagement can be successful without a well-planned system of communication. In the Army, efficient communication systems are maintained in time of peace as well as war. This makes it necessary for the Signal Corps to keep up-to-date, and, when possible, to be a little ahead of the times. Many commercial devices and systems now used were originated in the Signal Corps for military use long ago.

The Army Radio Net.

Today a network of radio stations extends to all quarters of the country, with a message center in Washington. High powered stations carry dispatches from coast to coast in record time, and no military command is out of touch with Washington for an appreciable length of time.

The installation of a system of modern, one and one-half kilowatt vacuum-tube stations connecting all centers of military activity has been practically completed. For the trans-continental circuit, stations have been established at New York, Washington, Indianapolis, Omaha, Salt Lake City and San Francisco, with one nearing completion at Cheyenne. Similar stations have also been installed at Atlanta and St. Louis. In addition, all the important Flying Fields will soon be connected with the radio system. Most of the big stations are equipped with remote control apparatus permitting operation of a transmitter at some distance and the reception of incoming messages by loops and six stage radio-frequency amplifiers in the main offices. Communication is maintained through these sets by means of the continuous wave telegraphy method but the stations are also equipped for radio telephone and buzzer, modulated radio telegraphy.

Field Operations

The importance of radio to an Army in the field was shown during the operations of the First American Army in the Meuse-Argonne battle, when six hundred radio receiving sets were used for receiving airplane reports alone. The operation and maintenance of these receiving sets required the services of about five thousand radio specialists, most of them recruited from the ranks of American amateurs at the outset of the war.

Radio for communication between infantry regiments and battalions is the most important link in action. Front line wired telephone and telegraph communication is constantly interrupted by shell fire and bombs. Farther to the rear, wire communication is more dependable, and there radio becomes more of an auxiliary service.

With the exception of brigade to regiment communication, which is spark radio, all ground radio within an American field army is of the vacuum-tube or continuous-wave type.

In army corps headquarters, as well as large artillery and air units, powerful vacuum-tube sets installed on tractors are employed. Divisions and regimental units in the field are equipped with compact chest-type tube sets. In advanced posts, "V"-shaped antenna supported by 20 feet bamboo poles are used. Battalion and regimental communication is handled on the small portable SCR-77 loop set, using tubes for both transmission and reception. Special portable sets have also been made up for cavalry, which are good for them 60 to 500 miles and are transported by mules.

Supervision in Samoa

Although the radio regulations for New Zealand have been extended to apply to Samoa, it is reported that more latitude is given the amateurs, and that an effort to regulate broadcasting stations is being made before interference begins. Samoa is designated as the fifth New Zealand radio district with the officer in charge of the Apia radio station as inspector of local reception and transmission.

Except that it is necessary to secure a license and pay a small license fee, amateurs are unrestricted in radio reception, but licenses are not to be issued for circuits which cause interference. Amateur transmitting stations in Grade I require the supervision of a licensed operator and are assigned on wave lengths between 150 meters and 180 meters, the power being limited to 50 watts. Grade II operators are restricted to a 140 meter wave, and five watts in power. All amateur transmission is prohibited between 7 and 8 p. m.

Welcome, WJAZ

Probably the most picturesquely located high power broadcasting station in the United States is the new station installed by E. F. McDonald of the Chicago Radio Laboratories in the Edgewater Beach hotel, Chicago. The studio and operating room are enclosed in triple plate glass in richly appointed chambers off the Marine dining room of the hotel on the main floor. The operator of the studio may be observed by those in the dining room.

On the east side the waves of Lake Michigan roll up to within a few feet of the foundation of the building.

The studio is draped in cherry-red velvet and is not only perfectly soundproof but is an outstanding example of the modern trend toward elegance in appointment and decoration.

Mr. McDonald is to be congratulated on having installed such a station in so central a location. The formal opening of the station on Saturday night, May 12, was an occasion that interested radio and musical circles generally.

The modulation acquired by the operators of the station was instantly acclaimed as approaching perfection. Mr. McDonald also indicated a fine discrimination in the selection of his musical numbers. Those who have been listening in on WJAZ are expressing the belief that the station will be accepted as the standard of excellent transmission and of quality entertainment, at least in the Middle West.

With such equipment and with such a favorable impression already established on music lovers it is expected that the station will carefully avoid those advertising stunts which certain other stations have used to boost receiving sets, automobile bumpers, and what not.

590 Stations

Washington, D. C.—The process of allocating new wave lengths and reclassifying radio broadcasting stations is a slow one. Department of Commerce Radio officials have announced they would issue a complete list of the three classes stations with their wave lengths until about May 15, when the Class B stations started operating on their exclusive national waves.

On May 4, there was a total of 590 broadcasting stations, including 32A, 32B and 528 C stations. During the last month 23 new stations were licensed, ten were transferred from Class C on 360 meters to Class A, and 14 were dropped from the Department's lists.

Sixteen new stations in eleven different states were licensed during the past week, among them were two churches, two colleges, a high school, a military unit and a newspaper.

Complete Corrected List of U. S. and Canadian Broadcasting Stations

Complete Each Issue

THE list of broadcasting stations on these pages is brought up to date each month by additions of new stations and deletion of those which have suspended operation. The list is the product of a vast volume of correspondence and its completeness is due in large measure to the assistance of our special news service in Washington, D. C. Suggestions, corrections and additional data will be welcomed from readers. Broadcasters: Send in your program schedules.

Wave lengths assigned to stations by the Department of Commerce, so far as the announced, will be found in a table on another page.

1XAD, Pawtucket, R. I. 1000 miles; Special license experimental; Standard Radio & Electric Co.
KDKA, E. Pittsburg, Pa.; Class B station Westinghouse Elec. & Mfg Co.
KDN, San Francisco, Calif.; Leo J. Meyberg Co.
KDOW, Steamship America, New York.
KDPM, Cleveland, Ohio; Westinghouse Elec. & Mfg. Co.
KDPT, San Diego, Calif.; Southern Elec. Co.
KDYL, Salt Lake City, Utah; news music, entertainment, Telegram Publishing Co.
KDYM, San Diego, Calif.; Savoy Theatre.
KDYQ, Portland, Ore.; Oregon Inst. Technology.
KDYS, Great Falls, Mont.; Class B, Great Falls Tribune.
KDYW, Phoenix, Arizona; Smith Hughes & Co.
KDYX, Honolulu, T. H; 12:15 to 1:15 p. m., stock reports and weather; 6:30 to 7:30 p. m., music, lectures; Sunday, 11 a. m. to 12:30 p. m., sermons; Honolulu Star-Bulletin, Ltd.
KDZB, Bakersfield, Calif.; Frank E. Seiffert.
KDZE, Seattle, Wash.; Rhodes Co.
KDZF, Los Angeles, Calif.; Automobile Club of Southern California.
KDZG, San Francisco, Calif.; Cyrus Pierce & Co.
KDZH, Fresno, Calif.; Fresno Evening Herald, Class B.
KDZI, Wenatchee, Wash.; Electric Supply Co.
KDZK, Reno, Nev. Wednesday 8 to 9 p m; Friday 8 to 9 p m. Musical and news features; Nevada State Journal, Nevada Machinery & Electric Co.
KDZQ, Denver, Colo. Pyle & Nichols, 1247 Broadway.
KDZR, Bellingham, Wash; 261 meters, 50 watts; Bellingham Pub. Co.
KDZX, San Francisco, Calif.; Glad Tidings Tabernacle.
KFAD, Phoenix Ariz.; Class B, McArthur Bros. Mercantile Co.
KFAE, Pullman, Wash.; State College of Washington.
KFAF, Denver, Colorado; George S. Walker, Western Radio Corporation; musical programs, news items, etc., daily except Tuesday and Sunday, 8 to 9 p m; mountain standard time.
KFAJ, Boulder, Colo.; University of Colorado.
KFAN, Moscow, Idaho; Electric Shop.
KFAP, Butte, Mont.; Standard Pub. Co.
KFAQ, San Jose, Calif.; City of San Jose.
KFAR, Hollywood, Calif.; Studio Lighting Service Co.
KFAT, Eugene, Ore. Monday, Wednesday and Saturday 8 to 9 p m Music; Sunday 8:30 to 9:15 Church Services; Pacific Radio Co.
KFAU, Boise, Idaho; Class B, Boise High School.
KFAV, Venice, Calif.; Abbott Kinney Co.
KFAW, Santa Anna, Calif.; Class B, Radio Den.
KFAY, Central Point, Ore.; W. J. Virgin Milling Co.
KFAZ, Reddley, Calif., C. H. Weatberll.
KFBB, Havre, Mont.; F. A. Buttrey & Co.
KFBC, San Diego, Calif.; W. K. Azbill.
KFBD, Hanford, Calif.; California Radio Lab.
KFBE, San Louis Obispo, Calif.; R. H. Horn.
KFBG, Tacoma, Wash.; First Presbyterian Church.
KFBH, Marshfield, Ore.; Thomas Musical Co.
KFBK, Sacramento, Calif., 2,000 miles; daily, 3 to 4 p m and 6 to 6:30 p m; Sunday and Thursday 8 to 9 p m; Kimball-Upson Co. and Sacramento Union.
KFBL, Everett, Wash.; Leese Bros.
KFBU, Laramis, Wyo.; N. S. Thomas.
KFBC, Phoenix, Ariz.; Nielson Radio Supply Co.
KFCD, Salem, Ore.; F. S. Bartin.
KFCF, Walla Walla, Wash.; Frank A. Moore.
KFCH, Billings, Mont.; Elec. Service Station.
KFCK, Colorado Springs, Colo.; Colorado Springs Radio Co
KFCL, Los Angeles, Calif.; Los Angeles Union Stock Yards.
KFCM, Richmond, Calif., Richmond Radio Shop.
KFCQ, Casper, Wyo.; Motor Service Station.
KFCP, Ogden, Utah, Ralph W. Flygare.
KFCV, Houston, Tex., Fred Mahaffey, Jr.
KFCY, Le Mars, Ia.; Western Union College.
KFCZ, Omaha, Nebr.; Omaha Central High School.
KFDA, Baker, Ore.; Adler's Music Store.
KFDB, San Francisco, Calif.; Mercantile Trust Co.
KFDD, Boise, Idaho; St. Michael's Cathedral.
KFDO, Bozeman, Mont.; Everett H. Cutting.
KFDP, Des Moines, Ia.; Hawkeye Radio & Supply Co.
KFDS, San Francisco, Calif.; John D. McKee.
KFDU, Lincoln, Nebr.; Nebraska Radio Electric Co.
KFDV, Fayetteville, Ark.; Gilbreeb & Stinson.
KFDY, Brookings, S. D.; South Dakota State College of Agriculture and Mechanical Arts.
KFDL, Denver, Colo.; Knight Campbell Music Co.
KFDJ, Corvallis, Ore.; Oregon Agri. College.
KFDC, Spokane, Wash.; Radio Supply Co.
KFDF, Casper, Wyo.; Wyoming Radio Corp.
KFDR, York, Nebraska; Bullock's Hardware & Sporting Goods.
KFDX, Shreveport, La.; First Baptist Church.
KFDZ, Minneapolis, Minn.; Harry O. Iverson.
KFEB, Taft, Calif.; City of Taft.
KFEC, Portland, Ore.; Meier & Frank Co.
KFEJ, Tacoma, Wash.; Guy Greason.
KFEL, Denver, Colo., Winner Radio Corp.
KFEP, Denver, Colo., Radio Equipment Co.
KFEQ, Oak Nebraska; J. L. Scroggin.
KFEQ, Oak, Nebraska; J. L. Scroggin.
KFER, Ft. Dodge, Iowa; 231 meters, 10 watts; Auto Electric Service Co.
KFEV, Douglas, Wyo.; Entertainment and weather; Radio Electric Shop.
KFEX, Minneapolis, Minn; 261 metere, 100 watts Augsburg Seminary.
KFEY, Kellogg, Idaho; Bunker Hill & Sullivan Mining & Construction Co.
KFFZ, Dallas, Texas; 226 meters, 20 watts; A. G. Barnes Amusement Co.
KFEZ, St. Louis, Mo.; American Society of Mechanical Engineers.
KFFA, San Diego, Calif.; Dr. R. C. Shelton.
KFFE, Pendleton. Ore.; Eastern Oregon Radio Co.
KFFO, Hillsbors, Oregon; Dr. E. H. Smith.
KFFP, Moberly, Missouri; First Baptist Church.
KFFQ, Colorado Springs, Colo., Marksheffel Motor Co.
KFFR, Sparks, Nev.; Jim Kirk.
KFFV, Lamoni, Iowa; Graceland College.
KFFX, Omaha, Neb; 278 meters, 250 watts; The McGraw Co.
KFFY, Alexandria, La; 275 meters; 100 watts; Pincus & Murphy Inc.
KFGB, Pueble, Co., Loewenthal Bro.
KFGC, Baton Rouge, La; 254 meters, 100 watts; Louisiana State University.
KFGD, Chickasha, Okla.; 248 meters, 20 watts; Chickasha Radio & Elect. Co.
KFGF, Mt. Vernon, Wash.; Buchanan, Stevens & Co.
KFGH, Stanford Univ., Calif.
KFGJ, St. Louis, Mo.; 266 meters, 100 watts; Nat'l Guards Missouri 138 Infantry.
KFGL, Arlington, Oregon; Arlington Garage.
KFGM, Abilene, Texas; 233 meters, 100 watts; Abilene Daily Reporter.
KFGP, Cheney, Kansas; 229 meters, 10 watts; Cheney Radio Company.
KFHA, Gunnison, Colo.; Colorado State Normal School.
KFHB, Hood River, Oregon; P. L. Boardwell.
KFHC, Norman, Oklahoma; 254 meters, 10 watts; University of Oklahoma.
KFHD, St. Joseph, Mo.; 226 meters, 10 watts; Utz Electric Co.
KFHF, Shreveport, La 266 metere, 150 watts; Central Christian Church.
KFGQ, Boone, Iowa; 226 meters, 20 watts; Crary Hardware Co.
KFGZ, Berrien Springs, Mich; 268 meters, 10 watts; Emmanuel Missionary College.
KFGX, Orange, Texas; 250 meters; 500 watts; First Presbyterian Church.
KFGY, Baudette, Minn; 224 meters, 15 watts; Gjelhayg's Radio Shop.
KFHH, Neah Bay, Wash.; Ambrose McCue.
KFHI, Wichita, Kansas; 224 meters, 20 watts; Charles V. Dixon.
KFHJ, Santa Barbara, Calif., Fallon Co.
KFID, Iola, Kansas, 246 meters, 20 watts; Ross Arbuckle's Garage.
KFHL, Oskaloosa, Ia.; 227 meters, 10 watts; Penn College.
KFIQ, Yakima, Wash.; 224 meters, 50 watts; Yakima Valley Radio Broadcasting Association.
KFHR, Seattle, Wash.; Star Electric & Radio Co.
Paul Franklin Johnson, Altadena Radio Lab.
KFI, Los Angeles, Calif.; radiua covers entire U. S. and Canada; Daily, 6:45 to 11 p. m. Sunday 10 to 11 a. m., 4 to 4:30 and 8 to 11 p. m.; entertainment and educational features; station operates three remote control stations; Earle C. Anthony, Inc.
KFIB, St. Louis, Mo.; 214 meters, 10 watts; Franklin W. Jenkins.
KFIF, Portland, Ore.; Benson Tech. Student Body.
KFIC, Denver, Colorado; 224 meters, 15 watts; Philip Laskowitz.
KFIU, Gridley, Calif.; The Precision Shop.
KFV, Yakima, Wash.; Foster-Bradbury Radio Store.
KFZ, Spokane, Wash.; Doerr-Mitchell Elec. Co.
KGB, Tacoma, Wash., Sunday: 5 to 7:30; Daily: 7 to 9 p. m. (except Thursday) News, Sport bulletins, lectures, entertainment, weather, tide tables, bedtime stories, time, etc.; Tacoma Daily Ledger station operated by the William A. Mullins Electric Co.
KGG, Portland, Ore.; Hallock & Watson Radio Service.
KGN, Portland, Ore.; Northwestern Radio Mfg. Co.
KGO, Altadena, Cal. 2500 miles; every Saturday 8 to 9:30 p m Musical program;
KGU, Honolulu, Hawaii, Waikiki Beach, Marion A. Mulroney; Honolulu Advertiser
KGW, Portland, Ore.; Oregonian Pub. Co.
KGY, Lacey, Wash.; St. Martin's College, (Rev. S. Ruth).
KHJ, Los Angeles, Calif.; Daily except Sunday: 12:30 p. m. to 1:15 p. m. news and concerts; 7 to 7:30 p. m. Children'e Half Hour; 8 to 9:30 p. m. De Luxe program of music, news and educational featuree; Sunday: 10 to 11 a. m. Scripture reading, sermon, prayer and sacred musical program; Pacific time; Times-Mirror company.
KHQ, Seattle, Wash.; Louis Wasmer.
KJJ, Sunnyside, Calif.; The Radio Shop.
KJQ, Stockton, Calif.; C. O. Gould.
KJS, Los Angeles, Calif.; Bible Inst. of Los Angeles.
KLB, Pasadena, Calif.; J. J. Dunn & Co.
KFDH, Tucson, Ariz.; Univ. of Arizona.
KLS, Oakland, Calif.; Warner Bros.
KLX, Oakland, Calif.; Tribune Pub. Co.
KLZ, Denver, Colo.; Class B, 485, Reynolds Radio Co.
KMAZ, Macon, Ga., Mercer University.
KMC, Reedley, Calif.; Lindsay-Wetherill Co.
KMJ, Fresno, Calif. Max. 2576 Miles; Musical program, San Joaquio Light & Power Corp.
KMO, Tacoma, Wash., Love Electric Co.; Tacoma Times.
KNI, Eureka, Calif.; T. W. Smith.
KNJ, Roswell, New Mexico; 1000 miles; Every evening at 8; news, weather reports, stock market, concerts and sermons; Roswell Public Service Co.
KNN, Los Angelee, Calif.; Bullocks.
KNT, Aberdeen, Wash.; North Coast Products Co.
KNV, Los Angeles, Calif.; Radio Supply Co.
KNX Los Angeles, Calif.; Electric Lighting Supply Co.
KOA, Denver, Colo.; Y. M. C. A.
KDB, State College, N. Mex.; time signals and weather reports 12 noon and 10: p m, mountain time; music and lectures Monday, Wednesday and Friday, 7:30 to 8:30 p m; New Mexico College of Agriculture and Mechanical Arts.
KDE, Spokane, Wash.; Spokane Chronicle.
KDP, Detroit, Mich., Detroit Police Dept.
KDQ, Modesto, Calif., Modesto Evening News.
KPD, San Francisco, Calif., Hale Bros.
KQI, Berkeley, Calif., Univ. of California.
KQP, Hood River, Oregon; Apple City Radio Club.
KQV, Pitteburgh, Pa., Doubleday-Hill Elec. Co.
KQW, San Jose, Calif., Chas. D. Herrold.
KQY, Portland, Ore; 1,000 miles, Monday, Tuesday, Saturday, 9 to 10 p m; Wednesday, Thursday, Friday, 6 to 7 p m; Stubbs Electric Co.
KRE, Berkeley, Calif., Maxwell Electric Co.
DSC, San Jose, Calif., O. A. Hale & Co.
KSD, St. Louis, Mo.; 1700 miles; grain, livestock, cotton, New York stocks, poultry and butter market, metal market, official weather and news at 9:40, 10:40, 11:40, 12:40, 1:40, 2:40 and 4 p m; 8: p m 400 meters, musical and other features; Pulitzer Publishing Co., St. Louis Post Dispatch.
KSL, San Francisco, Calif., The Emporium.
KSS, Long Beach, Calif., Prest & Dean Radio Research Lab.
KSU, Wenatchee, Wash.
KTW, Seattle, Wash., First Presbyterian Church.
KUO, San Francisco, Calif., Examiner Printing Co., San Fran. Examiner.
KUS, Los Angeles, Cal. 500 miles; setting up exercises daily, 7 to 7:30 a m and 12:00 noon to 12:30 p m; concert, 65 voices, 6 to 6:45 p m, Wednesdays and Fridays; City Dye Works.
KUY, Del Monte Calif., Coast Radio Co.
KWG, Stockton, Cal. Daily Market reports, music and newe 4 to 5 p m; Music, 2 to 3 p m, Sunday; Tuesdays and Fridaye, music, 8 to 9 p m. Portable Wireless Telephone Co.
KWH, Los Angeles, Calif., Los Angeles Examiner.
KXD, Modesto, Calif., Herald Publishing Co.
KYI, Bakersfield, Calif., Alfred Harrell.
KYJ, Los Angeles, Calif., Leo J. Meyberg Co.
KYQ, Honolulu, T. H., The Electric Shop.
KYW, Chicago, Ill.; Westinghouse Elec. & Mfg. Co. 345 meters.
KZM, Oakland, Calif., Western Radio Inst.; Preston D. Allen
KZN, Salt Lake City, Utah, The Deseret News.
KZV, Wenatchee, Wash., Wenatchee Battery & Motor Co
NOF, Anacostia, D. C., U. S. Navy Dept.
PWX, Havana, Cuba, Cuban Telephone Co.
WABD, Dayton, Ohio; 286 meters, 10 watts; Parker High School.
WAI, Dayton, Ohio, McCook Field, U. S. Army.
WAAB, New Orleans, La., Waldemar Jensen.
WAAC, New Orleans, La., Tulane Univ.
WAAD, Cincinnati, Ohio, Ohio Mechanics Inst.
WAAF, Chicago, Ill., Chicago Daily Drovers Journal.

Complete Corrected List of U. S. and Canadian Broadcasting Stations

WAAE, St. Louis, Mo., St. Louis Chamber of Commerce.
WAAH, St. Paul, Minn.; Commonwealth Electric Co.
WAAJ, Boston, Mass., Eastern Radio Inst.
WAAK, Milwaukee, Wis., Gimbel Bros.
WAAL, Minneapolis, Minn., Minnesota Tribune Co. & Anderson-Beamish Co.
WAAM, Newark, N. J, 200 miles; musical and code, every week day 11 to 11:55 a m, 3 to 4 p m; Wednesday evenings 8 to 9; I. R. Nelson Company.
WAAN, Columbia, Mo., Univ. of Missouri.
WAAP, Wichita, Kans., United Elec. Co.; Otto W. Taylor.
WAAQ, Greenwich, Conn., New England Motor Sales Co.
WAAS, Decatur, Ga., Georgia Radio Co.
WAAT, Jersey City, N. J., Jersey Review.
WAAW, Omaha, Neb., Omaha Grain Exchange.
WAAY, Youngstown, Ohio, Yohrling Rayner Music Co.
WAAZ, Emporia, Kans.; Daylite 100 miles; nite 500-1000 miles; each Tuesday and Thursday from 7 to 8 p m. Acknowledge all communications at 7:15 p m. The Hollister Miller Motor Co.
WABA, Lake Forest, Ill; 266 meters, 100 watts; Lake Forest College.
WABB, Harrisburg, Pa; 266 meters, 10 watts; Dr. John B. Lawrence.
WABC, Anderson, Ind; 299 meters, 10 watts, Fulwider-Grimes Battery Co.
WABD, Dayton, Ohio; 286 meters, 10 watts; Parker High School.
WABE, Washington, D. C; 283 meters, 50 watts; Y. M. C. A.
WABF, Mt. Vernon, Ill; 234 meters, 250 watts; Mt. Vernon Register-News Co.
WAGB, Jacksonville, Fla; 248 meters, 10 watts; Arnold Edwards Piano Co.
WAJT, Marshall, Mo., Kelly-Vawter Jewelry Co.
WAJU, Yankton, S. D., Yankton College.
WABH, Sandusky, Ohio; 234 meters, 100 watts; Lake Shore Tire Co.
WBAA, W. Lafayette, Ind., Purdue University.
WBAD, Minneapolis, Minn., Sterling Elec. Co. & Journal Printing Co.
WBAE, Peoria, Ill., Bradley Polytechnic Inst.
WBAF, Moorestown, N. J., Fred M. Middleton.
WBAG, Bridgeport, Pa., Diamond State Fibre Co
WBAM, New Orleans, La., I. B. Rennyson.
WBAN, Paterson, N. J., Wireless Phone Corp.
WBAD, Decatur, Ill.; 100 miles; occasional music; sermons; James Millikin Univ.
WBAP, Fort Worth, Tex.; 4000 miles; Markets and News; Feature concert Monday to Friday inclusive; 9:30 p m to 10:45 p m, Central Time; Quiet nights Saturday and Sunday. The Star-Telegram.
WBAQ, South Bend, Ind., Myron L. Harmon.
WBAU, Hamilton, Ohio, Republican Publishing Co.
WBAV, Columbus, Ohio, Erner & Hopkins Co.
WBAW, Marietta, Ohio, Marietta College.
WBAX, Wilkes-Barre, Pa., John H. Stenger, Jr.
WBBA, Newark, O.; 240 meter, 20 watts; Newark Radio Lab.
WBBC, Sterling, Ill; 229 meter, 50 watts; Sterling Radio Equipment Co.
WBL, Anthony, Kans., T. & H. Radio Co.
WBS, Newark, N. J.; Radius 500 mi.; Musical and Educational, week days: 10:30 to 11 a. m.; 1:00 to 1:15 p. m.; 2:15 to 2:30 p. m.; 7:30 to 8:30 p. m.; Sundays, 9 to 10:30 a m; 1 to 3 p m; D. W. May, Inc.
WBT, Charlotte, N. C. 1200 miles; 11: a m weather report 485; 4:30 p m mechanical music; 8: p m Market Report; 8:30 Tuesday and Friday regular concert; 7:30 p m Sunday, Church Southern Radio Corp.
WBU, Chicago, Ill., City of Chicago.
WBZ, Springfield, Mass., Westinghouse Elec. & Mfg. Co.
WCAB, Newburgh, N. Y., Newburgh Daily News; Newburgh News Printing & Pub. Co
WCAC, Fort Smith, Ark., John Fink Jewelry Co.
WCAD, Canton, N. Y., St. Lawrence University.
WCAE, Pittsburgh, Pa.; 12:30 news and reports; 3:30 weatehr reports; 4:15 Closing Market reports; 7:30 Late news and lecture; 8:30 musical programs; Kaufmann Baer Co.
WCAG, New Orleans, La., Daily States Pub. Co.
WCAH, Columbus, O. Daily program 11:30 to 12:30; Every Tuesday evening at 7. musical program; C. A. Entrekin Electric Co.
WCAI, San Antonio, Texas, Southern Equipment Co.
WCAJ, Univ. Place, Neb., Nebraska Wesleyan University.
WCAK, Houston, Texas, Alfred P. Daniel.
WCAL, Northfield, Minn., St. Olaf College.
WCAM, Villanova, Pa., Villanova College.
WCAD, Baltimore, Md., Sanders & Stayman Co.
WCAR, San Antonio, Texas, Alamo Radio Elec. Co.
WCAS, Minneapolis, Minn., Wm. H. Dunwoody Industrial Inst.
WCAT, Rapid City, S. Dak., South Dakota School of Mines.
WCAU, Philadelphia, Pa.; 1000 miles; Daily 10:30 a. m.; 2:30 p. m.; 6:30 p m; regular concert 10 to 12 noon; Tuesdays, Fridays, Saturdays; Durham & Co., Inc.
WCAV, Little Rock, Ark., J. C. Dice Elec. Co.
WCAW, Omaha, Nebr., Woodmen of the World.
WCAX, Burlington, Vermont, University of Vermont.
WCAY, Milwaukee, Wis., Kesselman O'Driscoll Co
WCBB, Greenville, O.; 240 meters, 100 watts; K. & K. Radio Supply Co.
WCE, Minneapolis, Minn., Findley Elec. Co.
WCK, St. Louis, Mo., Stix Baer & Fuller.
WCM, Austin, Texas, Univ. of Texas.
WCN, Worcester, Mass., Clark University.
WCX, Detroit, Mich., Detroit Free Press.
WDAC, Springfield, Ill., Ill Watch Co.
WDAD, Lindsburg, Kas.; Central Kansas Radio Supply.
WDAE, Tampa, Fla.. Tampa Daily News.
WDAF, Kansas City, Mo., also Kansas City Star.
WDAG, Amarillo, Texas, K. Laurence Martin.
WDAG, Brownsville, Pa.. Hartman-Riker Elec. & Mach.Co.
WDAH, ElPaso, Tex.; Trinity Methodist Church.
WDAI, Syracuse, N. Y., Hughes Electrical Corp.
WDAJ, College Park, Ga., Atlanta & West Point R. R. Co.
WDAK, Hartford, Conn., Hartford Courant.
WDAL, Jacksonville, Fla., Florida Times Union.
WDAO, Dallas, Texas, Automotive Elec. Co.
WDAP, Chicago, Ill., markets, and concerts 360; Daily on all business days: 9:30 a. m. receipts and shipments; estimated car lots; local weather report; opening futures market in wheat, corn, oats, rye, barley, pork, lard and ribs. 10 a. m. Future quotations, live stock receipts and prices; 10:30 a. m. futures quotations; 11 and 11:30 a m. same; 12 noon, futures and cash grain prices; 12:30 and 1 p. m. futures quotations; 1:20 p. m. closing futures quotations and high and low for day. Cash grain prices. Gross bids for cash grain to arrive. 6 p. m. closing quotations; news items. On Saturdays closing prices at 12:05 p. m. instead of 1:20 p. m. Visible supply changes sent when posted. Regular concert schedule 10 p. m. Tuesdays, Thursdays and Saturdays. Sunday evenings 9 p. m. and 10 p. m. Chicago Board of Trade official station.
WDAR, Philadelphia, Pa.; Lit Brothers.
WDAS, Worcester, Mass., Samuel A. Waite.
WDAU, New Bedford, Mass., Slocum & Kilburn.
WDAX, Centerville, Iowa, First Nat'l Bank.
WDAY, Fargo, N. D.; 244 meters, 50 watts; Fargo Radio Service Co.
WDM, Washington, D. C., Church of the Covenant.
WDT, New York, N. Y., Ship Owners Radio Service.
WDZ, Tuscola, Ill., James L. Bush.
WEAA, Flint, Mich., Fallain & Lathrop.
WEAB, Fort Dodge, Iowa, Standard Radio Equip. Co.
WEAD, Atwood, Kans., Northwest Kansas Radio Supply Co.
WEAE, Blacksburg, Va., Virginia Polytechnic Inst.
WEAF, New York City, N. Y., Western Electric Co.
WEAG, Edgewood, R. I., Nichols-Hineline-Bassett Lab.
WEAH, Wichita, Kans., Wichita Board of Trade and Lander Radio Co
WEAI, Ithaca, N. Y., Cornell University.
WEAJ, Vermilion, S. Dak., University of South Dakota.
WEAK, St. Joseph, Mo., Julius B. Abercrombie.
WEAM, North Plainfield, N. J., Burough of N. Plainfield.
WEAN, Providence, R. I., The Shepard Co.
WEAO, Columbus, Ohio, Ohio State University.
WEAP, Mobile, Ala., Mobile Radio Co.
WEAQ, Berlin, N. H., Y. M. C. A.
WEAR, [illegible]
WEAT, Tampa, Fla., John J. Fogarty.
WEAU, Sioux City, Iowa, Davidson Bros. Co.
WEAV, Rushville, Nebr., Sheridan Elec. Service Co
WEAX, Little Rock, Ark.. T. J. M. Daly.
WEAY, Houston, Texas, Will Horwitz, Jr.
WEAZ, Waterloo, Iowa, Donald Redmond.
WEB, St. Louis, Mo., The Benwood Co., Inc.
WEH, Tulsa, Okla., Midland Refining Co.
WEV, Houston, Texas, Hurlburt-Still Elec. Co.
WEW, St. Louis, Mo., St. Louis Univ.
WEW, St. Louis, Mo., Market and weather reports at 9 a. m., 10 a. m., and 2: p m; no other regular program; St. Louis University.
WEY, Wichita, Kansas, Cosradio Co.
WFAA, Dallas, Texas. A. H. Belo & Co.
WFAV, Miami, Fla., 1500 miles; 7:30 to 9 p. m. concerts including Arthur Pryor's Band evenings and W. J. Bryan Sunday School, Sunday a m; Miami Daily Metropolis & Electrical Equipment Co.
WFAB, Syracuse, N. Y., C. F. Woese.
WFAC, Superior, Wis., Superior Radio Co.
WFAF, Poughkeepsie, N. Y., H. C. Spratley Radio Co.
WFAG, Waterford, N. Y., Radio Engineering Lab.
WFAH, Port Arthur, Texas, Elec. Supply Co.
WFAJ, Asheville, N. C., Hi-Grade Wireless Instrument Co.
WFAK, Brentwood, Mo., Domestic Electric Co.
WFAM, St. Cloud, Minn., Granite City Elec. Co. and Times Pub. Co.
WFAN, Hutchinson, Minn., Hutchinson Electric Service Co.
WFAQ, Cameron, Mo., Cameron Radio Co. and Mo. Wesleyan College
WFAT, Sioux Falls, S. Dak.; also Argus-Leader.
WFAU, Boston, Mass., Edwin C. Lewis.
WFAV, Lincoln, Nebr., Univ. of Nebr. Dept. of Elec. Engineering.
WFAZ, Charleston, S. Carolina, S. C. Radio Shop
WFI, Philadelphia, Penn., also Strawbridge & Clothier.
WGAC, Brooklyn, N. Y., Orpheum Radio Stores Co.
WGAD, Ensenada, Porto Rico, Spanish-American School of Radio-telegraphy
WGF, Des Moines, Iowa 300 miles; Musical and entertainment Tuesday and Friday 7:30 p m; Church Services Sunday at 5 p m or 7:45 p m as announced; Special programs as announced Register and Tribune.
WGAH, New Haven, Conn., New Haven Elec. Co.
WGAJ, Shenandoah, Iowa, W. H. Gass.
WGAL, Lancaster, Pa., Lancaster Elec. Supply & Construction Co.
WGAM, Orangeburg, S. C., Orangeburg Radio Equip. Co.
WGAN, Pensacola, Fla., Cecil E. Lloyd.
WGAQ, Shreveport, La., Glenwood Radio Corp.
WGAR, Fort Smith, Ark., Southwest American.
WGAU, Wooster, Ohio; 226 meters, 20 watts; Marcus G. Limb.
WGAV, Savannah, Ga., B-H Radio Co.
WGAW, Altoona, Pa., Ernest C. Albright.
WGAX, Washington Court House, Ohio, Ohio Radio Elec. Co.
WGAY, Madison, Wis., North Western Radio Co.
WGAZ, South Bend, Ind., South Bend Tribune.
WGI, Medford Hillside, Mass., Am. Radio & Research Corp.
WGL, Philadelphia, Pa., Thos. F. J. Howlett.
WGM, Atlanta, Ga., Atlanta Constitution.
WGR, Buffalo, N. Y., Federal Tel. & Teleg. Co.
WGV, New Orleans, La., Interstate Elec. Co.
WGY, Schenectady, N. Y., General Elec. Co.
WHA, Madison, Wis., Univ. of Wis.
WHAA, Iowa City, Ia; 500 miles; 8:30 p m, Monday, Instruction; Tuesday, concert Wednesday, popular lecture; Friday, University News; public lectures and concerts irregularly; State University of Iowa.
WHAB, Galveston, Texas, Clark W. Thompson (Fellman's Dry Goods Co.)
WHAC, Waterloo, Iowa. Cole Bros. Elec. Co.
WHAD, Milwaukee, Wis.; Marquette Univ.
WHAE, Sioux City, Iowa, Automotive Elec. Service Co.
WHAG, Cincinnati, Ohio, Univ. of Cincinnati.
WHAH, Joplin, Mo; radius, 1384 mi.;Concerts, markets, weather, etc. Tuesday and Thursday evenings: 8 to 10; Daily except Sundays: 10 a. m. to 2 p. m.; Saturday night special: 11 to 12:30; Hafer Supply Co.
WHAI, Davenport, Iowa, Radio Equip. & Mfg. Co.
WHAJ, Bluefield, W. Va., Bluefield Daily Telegraph and E. K. Kitts.
WHAK, Clarksburg, W. Va., Roberts Hdwe. Co.
WHAL, Lansing, Mich., Lansing Capitol News.
WHAM, Rochester, N. Y. Daily—Weather reports 2:40 p. m.; Organ 2:15, 5:00, 6:45; Orchestra 3:00, 7:00; Bed-time stories, Sport results, Business reports and market reports, the latter on 485 meters, 7:15 p m; Sunday—Radio Chapel Service, 3:15 p m; University of Rochester.
WHAD, Savannah, Ga., Frederick A. Hill; every evening 8 to 9; Saturday nights, 12:30 1:30 a. m.
WHAP, Decatur, Ill., Dewey L. Otta.
WHAQ, Washington, D. C., Semmes Motor Co.
WHAR, Atlantic City, N. J., Paramount Radio & Elec. Co.
WHAS, Louisville, Ky., Courier Journal and Louisville Times Co.
WHAV, Wilmington, Del., Wilmington Elec. Spec. Co.
WHAW, Tampa, Fla. 100 miles; 12 to 1, 4 to 5 p m, music; Pierce Electric Co.
WHX, Des Moines, Iowa; 300 miles; 5:45 p m to 6:15 p m Daily; 8:00 p m to 10 p m Wednesday evenings; Central Standard time; Iowa Radio Corp.
WHAY, Huntington, Ind., Huntington Press.
WHAZ, Troy, N. Y., Rensselaer Polytechnic Inst.
WHB, Kansas City, Mo., Sweeney Auto & Tractor School.
WHD, Morgantown, W. Va., W. Va. University.
WHK, Cleveland, Ohio, Warren R. Cox.
WHN, Ridgewood, N. Y., Times Printing & Pub. Co.
WHU, Toledo, Ohio, Wm. B. Duck Co.
WIAB, Rockford, Ill., Joslyn Automobile Co.
WIAC, Galveston, Texas, Galveston Tribune.
WIAD, Ocean City, N. J., Ocean City Yacht Club.
WIAE, Vinton, Iowa, Mrs. Robt. E. Zimmerman.
WIAF, New Orleans, La., Gustave A. De Cortin.
WJAG, Norfolk, Nebr; 200 miles News and Markets 12:15, 3:30 and 5:30 p. m The Huse Publishing Co. The Norfolk Daily News.
WIAH, Newton, Iowa, Continental Radio & Mfg. Co.
WIAI, Springfield, Mo.. Heer Stores Co.
WIAJ, Neenah, Wis., Fox River Valley Radio Supply Co.
WIAK, Omaha, Nebr.; 7:45 a. m. Livestock receipts; 9:10 a. m. Livestock receipts and opening on hogs; 10:15 a m rainfall and temperature report and weather forecast for Nebraska and Iowa, Livestock market; 12 m cattle, hog and sheep market; 1:50 p m rainfall and temperature report and weather forecast for Nebraska and Iowa; market detail; 3:50 p m complete market reports and estimated receipts for next day Daily Journal-Stockman.
WIAD, Milwaukee, Wis., School of Engineering.
WIAP, Springfield, Mass., Radio Development Corp.
WIAQ, Marion, Ind., Chronicle Pub. Co.
WIAR, Paducah, Ky., Musical 3:30 to 4 p. m. and 7 to 8 p. m. except Sundays Paducah Evening Sun: Albert Bennett, operator.
WIAS, Burlington, Iowa, Hawk-Eye Home Elec. Co.
WIAT, Tarkio, Mo., Leon T. Noel.
WIAU, Le Mars, Iowa, Am. Trust & Savings Bank.
WIAV, Binghamton, N. Y., N. Y. Radio Lab.
WIAW, Saginaw, Mich., Saginaw Radio & Elec. Co
WIAY, Neenah, Wis; 224 meter, 100 watts; Fox River Valley Radio Supply Co.
WIK, McKeesport, Pa., K. & L. Elec. Shop.
WIL, Washington, D. C., Continental Elec. Supply Co.
WIP, Philadelphia, Pa., Gimbel Bros.
WIZ, Cincinnati, Ohio, Cino Radio Mfg. Co.
WJAB, Lincoln, Nebr., American Radio Co.
WJAD, Waco, Texas. Jackson's Radio Engrng. Lab.
WJAF, Muncie, Ind; 1800 miles; 7:30 to 8 Monday, Wednesday, Friday evening music; 6:30 to 7 p m Saturday, music; 3:30 to 4 every afternoon, News; 10:30 to 12 M Sundays, Church service. Smith Electric-Muncie Press.

Complete Corrected List of U. S. and Canadian Broadcasting Stations

WJAJ, Dayton, Ohio 200 miles; Sunday 8:40, 9.15 Religious; Wednesday 9.15. 9:45 Entertainment; Friday 9:15 to 9:45 Entertainment. Y. M. C. A.
WJAK, Stockdale, Ohio White Radio Lab.
WJAM, Cedar Rapids, Iowa, Evening Gazette.
WJAN, Peoria, Ill; 280 meters, 100 watts; Daily except Sunday: 9 a. m. Peoria Livestock; 9:15 a. m. Special Weather Information; 11:30 a. m. weather, opening livestock and market quotations; 1:30 p. m. Closing livestock and markets, official weather information; talk to women by Phyills Ann; Monday and Thursday, government agriograms; 5:30 p. m. baseball reports during season; Tuesday, Thursday and Saturday, special concerts as announced at 9:15 p. m.; One musical number preceeds each broadcasting. Peoria Evening Star.
WJAP, Duluth, Minn. 1500 miles; Sunday 11 a m, 12:30 p m Church Service and organ recital; First Methodist Church, Rev. Chas. N. Pace, Pastor. Monday 8: p m to 9 p m, musical; Thursday 8 p m to 9 p m, musical; Kelley Duluth Co.
WJAQ, Topeka, Kans., Capper Publications.
WJAR, Providence, R. I., The Outlet Co., J. Samuels & Bros.
WJAS, Pittsburgh, Pa., Pittsburgh Radio Supply House.
WJAT, Marshall, Mo., Kelley-Vawter Jewelry Co.
WJAX, Cleveland, Ohio. Union Trust Co.
WJAZ, Chicago, Ill., Chicago Radio Lab.
WJD, Granville, Ohio; 229 meters, 50 watts; Richard Harris Howe.
WJH, Washington, D. C., White & Boyer Co.
WJX, New York, N. Y., De Forest Radio Telephone & Teleg. Co
WJZ, New York, Radio Corp. of America; Aeolin Hall, 455 meters.
WKAA, Cedar Rapids, Ia.; Daily; weatther reports, crop reports, government reports; Mondays, Thursdays and Saturdays: music; H. F. Paar.
WKAC, Lincoln, Neb., Star Pub. Co.
WKAF, Wichita Falls, Texas, W. S. Radio Supply Co.
WKAH, West Palm Beach, Fla., Planet Radio Co.
WKAK, Okemah, Okla., Okfuskee County News.
WKAL, Orange, Texas, Gray & Gray.
WKAN, Montgomery, Ala., Alabama Radio Mfg. Co.
WKAP, Cranston, R. I., Dutee W. Flint.
WKAQ, San Juan, Porto Rico, Radio Corp. of Porto Rico.
WKAR, East Lansing, Mich., Mich. Agrl. College.
WKAS, Springfield, Mo., L. E. Lines Music Co.
WKAV, Laconia, N. H., Laconia Radio Club.
WKAW, Beloit, Wis; 242 meters, 10 watts; Turner Cycle Co.
WKAX, Bridgeport, Conn., Wm. A. MacFarlane.
WKAY, Gainesville, Ga., Brenau College.
WKC, Baltimore, Md., Jos. M. Zamoiski Co.
WKN, Memphis, Tenn., Riechman-Crosby Co.
WKY, Oklahoma City, Okla., Oklahoma Radio Shop.
WLZ, Fairfield, Ohio, U. S. Army.
WLAC, Raleigh, N. C., N. C. State College.
WLAG, Minneapolis, Minn., Cutting & Walsh Radio Corp.
WLAH, Syracuse, N. Y., Samuel Woodworth.
WLAJ, Waco, Texas, Waco Elec. Supply Co.
WLAK, Bellows Falls, Vt., Vermont Farm Machine Co.
WLAL, Tulsa, Okla., Tulsa Radio Co.
WLAN, Houlton, Me., Putnam Hdwe. Co.
WLAP, Louisville, Ky., W. V. Jordan.
WLAQ, Kalamazoo, Mich., A. E. Schilling.
WLAS, Hutchinson, Kans., Hutchinson Grain Radio Co.
WLAT, Burlington, Iowa, Radio Specialty Co.
WLAV, Pensacola, Fla.; daily musical program, 8 to 9 p m; The Electric Shop.
WLAW, New York, N. Y., New York Police Dept.
WLAX, Greencastle, Ind., Greencastle Community Broadcasting Station.
WLAY, Fairbanks, Alaska, Northern Commercial Co.
WLAZ, Warren, Ohio, Hutton & Jones Elec. Co.
WLB, Minneapolis, Minn., Univ. of Minn.
WLK, Indianapolis, Ind., Hamilton Mfg. Co.
WLW, Cincinnati, Ohio, Crosley Mfg. Co.
WMA, Anderson, Ind., Arrow Radio Lab.
WMAB, Oklahoma City, Okla., Radio Supply Co.
WMAC, Cozenovia, N. Y, 750 miles; music 11: p m; Cleve B. Meredith.
WMAD, Rockport, Mo., Atchinson County Mail.
WMAE, Dartmouth, Mass., Round Hills Radio Corp.
WMAG, Liberal, Kans., Tucker Elec. Co.
WMAH, Lincoln, Nebr., General Supply Co.
WMAJ, Kansas City, Mo., Drovers Telegram.
WMAK, Lockport, N. Y., Norton Labs.
WMAL, Trenton, N. J, 100 miles; 7:30 to 9 p m, Mondays and Thursdays, musical programs, lectures etc; Trenton Hardware Co.
WMAM, Beaumont, Texas, Beaumont Radio Equip. Co.
WMAN, Columbus, Ohio, First Baptist Church.
WMAP, Easton, Pa., Utility Battery Service.
WMAQ, Fair Store Building, Chicago; 4:35 to 5 p m, daily; 7 to 7:30 p m, Monday, Wednesday, Friday and Saturday; 7 to 8 p m, Tuesday and Thursday; 9:15 to 10 p m daily; Chicago Daily News and Fair Department Store.
WMAR, Waterloo, Iowa, Waterloo Elec. Supply Co.
WMAT, Duluth, Minn., Paramount Radio Corp.
WMAV, Auburn, Ala., Polytechnic Inst.
WMAW, Wahpeton, N. D., Wahpeton Elec. Co.
WMAX, Ann Arbor, Mich., K. & K. Radio Supply Co.
WMAY, St. Louis, Mo., 600 miles; Religious services Sunday, 11 a m and 8 p m; Tuesday at 7 p m; Kingshighway Presbyterian Church.
WMAZ, Macon, Ga., Mercer University.
WMH, Cincinnati, Ohio, Precison Equipment Co.
WMU, Washington, D. C., Doubleday-Hill Electric Co.
WNAB, Bowling Green, Ky., Park City Daily News.
WNAC, Boston, Mass.; Monday 4 to 5 p. m. (silent at night) Tuesday 4 to 5 p. m. and 7 to 8:30 p. m. Wednesday 4 to 5 p. m. 9:30 to 11 p. m. Thursday 4 to 5 and 7 to 8:30 p. m. Friday 4 to 5 and 8 to 9:30 p. m. Saturday 4 to 5 and 9:30 to 11 p. m. The Shepard Stores; J. J. Fanning, announcer; Samuel Curtis, operator.
WNAD, Norman, Okla., Okla. Radio Engineering Co.
WNAL, Omaha, Nebr., R. J. Rockwell.
WNAN, Syracuse, N. Y., Syracuse Radio Telephone Co.
WNAP, Springfield, Ohio, Wittenberg College.
WNAQ, Charleston, S. C., Charleston Radio Elec. Co.
WNAS, Austin, Texas, Radio Corp.
WNAT, Philadelphia, Pa. 1000 miles; Talks, Radio information, music, Chapel Service. Wednesday 7:30 p m; Saturday 7:30 p m; Sunday 2:30 and 4:30; Every day 12:15, 1 p m. Lennig Bros. Co.
WNAV, Knoxville, Tenn., People's Tel. and Tel. Co.
WNAY, Baltimore, Md., Shipowners' Radio Service.
WNAW, Fortress Monroe, Va., Henry Kunzman.
WNAX, Yankton, S. Dakota; 244 meters, 100 watts; Dakota Radio Apparatus Company.
WNJ, Albany, N. Y., Shotton Radio Mfg. Co., Inc.
WNO, Jersey City, N. J., Wireless Telephone Co. of Hudson Co., N. J
WOAA, Ardmore, Okla.; radius 1,500 miles; Tuesdays and Fridays: musical and educational programs; Dr. Walter Hardy; station operated by G. H. Reltz.
WOAC, Lima, Ohio, Maus Radio Co.
WOAE, Fremont, Nebr., Medland College.
WOAF, Tyler, Texas, Tyler Commercial College.
WOAH, Charleston, S. C., Palmetto Radio Corp.
WOAI, San Antonio, Tex.; daily except Sunday 10:30, 12:15, 3, 6 p. m. News, market, weather reports; Wednesday. Concert 7:30 to 8:30 p. m.; Sunday evening concert 9:30 to 10:30 p m; Southern Equipment Co. and The Evening News and The Express.
WOAJ, Parsons, Kans., Erving's Electrical Co.
WOAK, Frankfort, Ky., Collins Hardware Co.
WOAL, Webster Groves, Mo., Wm. E. Woods.
WOAN, Lawrenceburg, Tenn., James D. Vaughan.
WOAQ, Omaha, Nebr. 100 miles; Woodmen of the World.
WOAQ, Portsmouth, Virginia; Portsmouth Kiwanis Club.
WOAR, Kenosha, Wis., Henry P. Lundskow.
WOAS, Middleton, Conn., Bailey's Radio Shop.
WOAT, Wilmington, Del., Boyd Martell Hamp.
WOAU, Evansville, Ind., Bowder Bolling Piano Co.
WOAV, Erie, Pa., Pa. Nat'l Guard.
WOAX, Trenton, N. J., Franklin J. Wolff.
WOAW, Omaha, Neb., 100 miles, Woodmen of the World.
WOAZ, Stanford, Texas, Penick Hughes Co.
WCBB, Greenville, O; 240 meters, 100 watts; K. & K. Radio Supply Co.
WOC, Davenport, Ia. time signals, 10:55 a. m.; weather 11 a. m.; 360 meters, 11:05 opening market quotations, agriograms; 12:00 noon, chimes concert; 2:00 p m, closing stocks and markets, 3:30 p m, educational talk, 5:45 p m chimes concert, 6:35, sandman's visit; 7:00 musical program, 8 p m, lecture, Sundays, religious and musical and religious features, 9 a m to 10 p m; Palmer's School of Chiropractic.
WOI, Ames, Ia., Iowa State College.
WOK, Pine Bluff, Ark., concerts Tuesday and Friday evenings beginning at 9; Sundays, song service and sermons from churches at 11 a. m. and 7:30 p. m., Arkansas Light & Power Co.
WOO, Philadelphia, Pa., John Wanamaker.
WOQ, Kansas City, Mo., Western Radio Co.
WOR, Newark, N. J., L. Bamberger & Co.
WOS, Jefferson City, Mo.; first fifteen minutes of every hour from 8 a. m. to 2: p m; 5 p m, markets and music, 360 meters; Monday, Wednesday, Friday nights, 8 to 9:30 concerts; no Sunday program; Missouri State Marketing Bureau.
WOV, Omaha, Nebr., R. B. Howell.
WOU, Omaha, Nebr., Metropolitan Utilities.
WPA, Fort Worth, Texas, Fort Worth Record.
WPAA, Wahoo, Neb., Anderson & Webster Elec. Co.
WPAB, State College, Pa.
WPAC, Okmulgee, Okla., Donaldson Radio Co.
WPAD, Chicago, Ill., Wieboldt & Co.
WPAF, Council Bluffs, Iowa, Peterson's Radio Co.
WPAG, Independence, Mo., Central Radio Co.
WPAH, Waupaca, Wis., Wisconsin Dept. of Markets.
WPAJ, New Haven, Conn., Doolittle Radio Corp.
WPAK, Fargo, N. D., North Dakota Agricultural College.
WPAL, Columbus, Ohio, Superior Radio & Tel. Equip. Co.
WPAM, Topeka, Kans., Awerbach & Guettel.
WPAP, Winchester, Ky., Theo. D. Phillips.
WPAQ, Frostburg, Md., General Sales & Eng. Co.
WPAQ, Wilmington, Del., Radio Installation Co., Inc.
WPAR, Beloit, Kans., R. A. Ward.
WPAS, Amsterdam, N. Y., J. & M. Electric Co.
WPAT, El Paso, Texas, St. Patrick's Cathedral.
WPAU, Moorhead, Minn., Concordia College.
WPAY, Bangor, Me., Bangor Radio Laboratory.
WPAZ, Charleston, W. Va., Dr. John R. Koch.
WPE, Independence, Mo.
WPG, New Lebanon, Ohio 1500 miles; Program exclusive for the farmer; 12 to 12:15 p m News Flashes; 6 to 6:30 p m, News, Markets; 8 to 9:45 Monday and Wednesday; music and farm program. Nushawg Poultry Farm.
WPI, Clearfield, Pa., Elec. Supply Co.
WPM, Washington, D. C., Thos. J. Williams, Inc.
WPO, Memphis, Tenn., United Equip. Co.
WSAC, Clemson College, S. C.; Clemson Agriculture College.
WQAA, Parkersburg, Pa. 1500 miles; 10:30 p m every evening. Horace A. Beale, Jr.
WQAB, Springfield, Mo., Southwest Missouri State Teachers' College.
WQAC, Amarillo, Texas, E. B. Glsh.
WQAD, Waterbury, Conn., Whitall Electric Co.
WQAE, Springfield, Vt., Moore Radio News Station.
WQAF, Sandusky, Ohio, Sandusky Register.
WQAH, Lexington, Ky., Brock-Anderson Elect. Eng Co.
WQAJ, Ann Arbor, Mich., Ann Arbor Times-News.
WQAK, Dubuque, Iowa, Appel-Higley Elec. Co.
WQAL, Mattoon, Ill., Cole County Tel. and Tel. Co.
WQAM, Miami, Fla., Electrical Equipment Co.
WQAO, New York, N. Y., Calvary Baptist Church.
WQAP, Lincoln, Nebr., Am. Radio Co.
WQAQ, Abilene, Texas, West Texas Radio Co.
WQAR, Muncie, Ind., Press Publishing Co.
WQAS, Lowell, Mass.; Prince-Walter Company.
WQAT, Westhampton, Va.; Radio Equipment Corp.
WQAV, Greenville, S. C.; Huntington & Guerry, Inc.
WQAW, Scranton, Pa., Scranton Times.
WQAW, Washington, D. C.; Catholic University.
WQAX, Peoria, Ill.; Radio Equipment Co.
WQAY, Hastings, Nebr., Gaston Music & Furniture Co.
WQAZ, Greensboro, North Carolina; Greensboro Daily News.
WRAA, Houston, Texas, Rice Institute.
WRAB, Savannah, Ga.; Savannah Board of Public Education.
WRAC, Mayville, N. D., State Normal School.
WRAD, Marion, Kansas. Taylor Radio Shop.
WRAF, Laporte, Ind; 224 meters, 10 watts; Radio Club, Inc.
WRAH, Providence, R. I.; Stanley N. Read.
WRAK, Escanaba, Mich.; Economy Light Co.
WRAL, St. Croix Falls, Wis.; Northern States Power Co.
WRAM, Carthage, Ill., Robert E. Compton & Carthage College.
WRAM, Galesburg, Ill., Lombard College.
WRAN, Waterloo, Iowa; 229 meters, 20 watts; Black Hawk Electrical Co.
WRAO, St. Louis, Mo., Radio Service Co.
WRAP, Winter Park, Fla.; Winter Park Electric Construction Co.
WRAS, McLeansboro, Ill.; Radio Supply Co.
WRAU, Amarillo, Texas, Daily News.
WRAV, Yellow Springs, O., Antioch College.
WRAY, Scranton, Pa.; radius 400 mi.; Sunday Chapel service; Wednesday; Selective Musical program, 8:15 to 10; Saturday: 8:15 to 11; Radio Sales Corp.
WRK, Hamilton, Ohio, Doron Bros. Elec. Co.
WRL, Schenectady, N. Y., Union College.
WRM, Urbana, Ill., Univ. of Ill.
WRP, Camden, N. J., Federal Inst. of Radio Telg.
WRR, Dallas, Texas, City of Dallas, Police and Fire Signal Dept.
WRW, Tarrytown, N. Y., Koenig Bros., Tarrytown Radio Research Lab.
WSAA, Marietta, O., B. S. Sprague Electric Co.
WSAB, Cape Girardeau, Mo., Southeast Mo. State College.
WSAC, Clemson College, S. C.; Clemson Agricultural College.
WSAH, Chicago, Ill.; A. G. Leonard, Jr.
WSAJ, Grove City, Pa., Grove City College.
WSAL, Brookville, Ind.; Franklin Electric Co.
WSAP, New York City; Seventh Day Adventist Church.
WSAT, Plainview, Texas, The Plainview Electric Co.
WSAV, Houston, Texas, C. W Vick Radio Const'n Co.
WSB, Atlanta, Ga., Atlanta Journal.
WSL, Utica, N. Y., J. & M. Elec. Co.
WSY, Birmingham, Ala., Alabama Power Co.
WTAC, Johnstown, Pa., Penn. Traffic Co.
WTAS, Elgin, Ill; 275 meters, 500 watts; Chas. E. Erbstein.
WTAU, Tecumseh, Neb., Ruegy Battery & Elec. Co.
WTAW, College Station, Texas, Agricultural and Mechanical College of Texas.
WTG, Manhattan, Texas, Kans. State Agri. College.
WTP, Bay City, Mich., Ra-Do Corp.
WVP, New York, N. Y. Signal Corps, U. S. Army.
WWAC, Waco, Tex; 3000 miles; Weather forecasts 11 a m daily; musical concerts. daily, 1:30 p m and on Wednesday and Saturday evenings at 8; Sanger Bros.
WWAD, Philadelphia, Pa., Wright & Wright, Inc.
WWAJ, Columbus, O.; Columbus Radio Club.
WWAX, Laredo, Texas, Worman Bros.
WWAY, Chicago, Ill.; Marigold Gardens.
WWB, Canton, Ohio, Daily News Printing Co.
WWI, Dearborn, Mich., Ford Motor Co.

(Continued on next page.)

Complete Corrected List of U. S. and Canadian Broadcasting Stations

WWJ, Detroit, Mich., Evening News.
WWL, New Orleans, La.; Musical and Educational; Loyola University; operated by Dept. of Physics.
WWX, Washington, D. C., Post Office Dept.
2XAI, Newark, N. J., Westinghouse Elec. & Mfg. Co.
2XI, New York City, A. T. & T. Co.
2XJ, Deal Beach, N. J., Amer. Tel. & Telg. Co.
3XW, Parkersburg, Pa., Horace A. Beale, Jr.
3YN, Washington, D. C., Nat'l Radio Inst.
9ARU, Louisville, Ky., Darrell A. Downard.

Canadian Stations

CFAC, Calgary, Alta., Can. Western Radio Co., Ltd.
CFCA, Toronto, Ont., Can. Toronto Star.
CFCB, Vancouver, B. C., Can. Marconi Co.
CFCE, Halifax, N. S., Can. Marconi Co.
CFCF, Montreal, P. Q., Can. Marconi Co.
CFCH, Iroquois Falls, Ont., Can. Abitibi Power & Paper Co.,, Ltd.
CFCI, Walkerville, Ont., Can. Motor Products Corp.
CFCN, Calgary, Alta., Can. W. W. Grant Radio, Ltd.
CFCX, London, Ont., Can. The London Advertiser.
CFPC, Fort Frances, Ont., Can. Internatoinal Radio Develop. Co.
CFTC, Toronto, Ont., Can. The Bell Telephone Co.
CFYC, Vancouver, B. C., Can. Victor Wentworth Odium.
CFZC, Montreal, Que., Can. Can. Westinghouse Co., Ltd.
CHBC, Calgary, Canada. W. W. Grant Radio, Ltd. (Morning Albertan.)
CHCA, Vancouver, B. C., Can. Radio Corp. of Vancouver, Ltd.
CHCB, Toronto, Can. Marconi Co.
CHCC, Edmonton, Alta., Can. Can. Westinghouse Co., Ltd.
CHCF, Winnipeg, Man., Can. Radio Corp. of Winnipeg, Ltd.
CHCQ, Calgary, Alta., Can. Western Radio Co., Ltd.
CHCS, London, Ont., Can. London Radio Shoppe.
CHCX, Montreal, Que., Can. B. L. Silver.
CHCZ, Toronto, Ont., Can. Globe Printing Co.
CHOC, Vancouver, B. C., Can. Can. Westinghouse Co., Ltd.
CHVC, Toronto, Canada. Metropolitan Motors Co.
CHXC, Ottawa, Ont., Can. J. R. Booth, Jr.
CHYC, Montreal, Que., Can. Northern Elec. Co.
CJBC, Montreal, Que., Can. Dupuis-Freres.
CJCA, Edmonton, Alta., Can. Edmonton Journal, Ltd.
CJCB, Nelson, B. C., Can. James Gordon Bennett.
CJCD, Toronto, Can., T. Eaton, Co.
CJCE, Vancouver, B. C., Can. Vancouver Sun.
CJCF, Kitchener, Ont., Can. News Record, Limited.
CJGG, Winnipeg, Canada. Manitoba Free Press.
CJCH, Toronto, Ont., Can. United Farmers of Ontario.
CJCI, St. John, N. B., Can. McLean, Holt & Co., Ltd.
CJCN, Toronto, Ont., Can. Simons, Agnew & Co.
CJCS, Halifax, N. S., Can. Eastern Telephone & Telegraph Co.
CJCY, Calgary, Alta., Can Edmund Taylor.
CJGC, London, Ont., Can. London Free Press.
CJNC, Winnipeg, Man., Can. Tribune Newspaper Co.
CJSC, Toronto, Ont., Can. Evening Telegram.
CKAC, Montreal, Can. La Presse.
CKCB, Winnipeg, Man. Can. T. Eaton Co., Ltd.
CKCD, Vancouver, B. C., Can. Vancouver Daily Province.
CKCE, Toronto, Ont., Can. Can. Ind. Telephone Co.
CKCK, Regina, Sask., Can. Leader Pub. Co.
CKCR, St. John, N. B., Can. Jones Elec. Radio Co., Ltd.
CKCS, Montreal, Que., Can. The Bell Telephone Co.
CKCZ, Toronto, Ont., Can. Westinghouse Co., Ltd.
CKKC, Toronto, Ont., Can. Radio Equipment & Supply Co., Ltd.
CKOC, Hamilton, Ont., Can Wentworth Radio Supply Co., Ltd.
CKQC, London, Ont., Can. Radio Supply Co.
CKZC, Winnipeg, Man., Can. Salton Radio Eng. Co.

The New Kaufman Circuit

(*Continued from page 4.*)

will be as short as possible. The base-board is fastened to the panel by means of three flat headed screws which should be countersunk so that the head of the screws will be level with the face of the panel.

The five holes shown above the rheostat are for the purpose of observing the brilliancy of the filament of the tube, when the set is enclosed in the cabinet. The arrangement as shown is supposed to slide into the front of the cabinet, in such a way that it may be drawn out at any time to change tubes, or to clear any trouble which might occur through wires becoming crossed, or connections which might come loose. However, if the wires are insulated with rubber tubing, or some other insulating material and the connections are all well soldered, no trouble of this kind may be expected.

If any of the new dry cell type of tubes are used, the rheostat should have from 25 to 30 ohms of resistance, which will give a very close adjustment of the filament control and also will prevent burning out the tube, if one happens to be a little careless in turning the rheostat, but if the ordinary 6 volt detector tube is used, then the regular 6 ohm type of rheostat will answer the purpose. Of course more volume may be obtained by using the standard UV-200, or Cunningham 300 tubes, but these will require the use of a storage battery for heating the filament, which may be objectionable in some cases, and especially so if the set is to be made portable.

Mr. Kaufman's idea in developing this circuit was to make a very efficient set and to do away with the obnoxious squealing and howling so often encountered in other kinds of tuners and in this respect he has done much to improve the results obtained on both local and long distance reception.

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The Monthly Service Bulletin of the

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Palmer School of Chiropractic
Davenport, Ia.

IN RESPONSE to the call for opinions from readers on the best way to solve the problem of restoring late popular music to the broadcasting stations many letters and telegrams have been received by the Secretary of the National Broadcasters League.

The call was published in the May issue of this magazine. In brief, it asked the following questions:

Can independent music be supplied so that popular music may feature broadcast programs?

Can this music be supplied without cost or tax?

Will it be possible to so direct such music distribution that an actual profit may be made for broadcast station owners?

Will independent authors, composers and publishers cooperate?

Will the receiving set owner assist in improving his own entertainment?

The answer to all of these questions is affirmative. From most of the states in the country and from provinces in Canada come letters showing deep interest in the music situation. It is significant that not one suggestion has come from any source defending the demand of the American Society of Authors, Composers and Publishers that the broadcasting stations pay a tax on the copyright music issued or controlled by that Society.

Basing their plans on these letters from all sources of radio interest the officers of the National Broadcasters' League have been conducting negotiations with the result that the actual distribution of untaxed music has started.

In the midst of these negotiations individual broadcasters of two cities inaugurated the organization of a few stations for similar purpose, with the exception that broadcasters, under their plan, were asked to invest a sum of money, in most cases equal to or greater than the tax demanded by the American Society of Composers, Authors and Publishers.

It should be kept in mind by all broadcasters that the National Broadcasters' League has no connection whatever with that recently announced grouping of a few stations who assumed a name similar to that of our older organization.

The National Broadcasters' League has no connection with the National Association of Broadcasters which recently met at the Drake Hotel, Chicago, and is not in sympathy with the demand of the National Association for the payment of considerable sums as membership fees by broadcasting stations, already under heavy expense and without present means of reimbursement for their investment or for their operating expenses.

Good, popular music is being selected by the officers of the League and is now being distributed on a periodical schedule which will insure each member station a well-rounded musical program without cost and without fear of legal complications over copyrights. Other branches of this service will be added from time to time.

Such a plan involves a great deal of labor and requires time. Broadcasters should bear in mind that in order to make it successful their full cooperation is essential. It gives the stations release from their worry over broadcasting of musical numbers and stations no doubt will show their appreciation by using the music and adhering, at least in an approximate way, to the schedules arranged.

There is another phase of the situation that should interest millions of owners of receiving sets. They are the ones who benefit from the musical entertainment offered by broadcasting stations. These fans could help right now by writing to their nearest broadcasting station and urging the owner of that station to join the National Broadcasters' League, immediately. The League's offices are at 500 North Dearborn street, Chicago. No station owner need hesitate because of the expense involved as the annual membership dues are only $10 and that sum covers all obligations for the term of one year.

Write your station about this. Tell the broadcasters the League is trying to help radio programs and that cooperation is necessary to bring it about.

Fans who are willing to do their part in obtaining better music and continuous music should sign the blank form printed on page 16 of this issue and send it at once to the National Broadcasters' League, 500 North Dearborn Street, Chicago. Sign and mail now.

OWNERS of broadcasting stations who have not yet joined the National Broadcasters' League, may do so by sending their check for the annual membership fee of $10 to Frederick Smith, Secretary, 500 N. Dearborn St., Chicago.

Membership will entitle broadcasters to periodical information as to developments in connection with broadcasting, intelligence as to steps taken to eliminate interference and news of events in any part of the country affecting broadcasting and broadcasting interests. Also members will receive the official organ of the league for one year.

This nominal fee is required for the cost of issuing circulars and handling the large volume of correspondence. You will find it useful to be associated directly with this clearing house for broadcasting information, which is also a protective institution, offensive and defensive.

Broadcasters Must Not Exceed Their Waves

UNDER the reallocation of wave lengths, six new stations were licensed by radio inspectors of various districts. Texas, Oklahoma, Illinois, Pennsylvania, Louisiana and Indiana each received one station with a wave exclusive for its representative district.

The schedule of Class A stations show that at least twenty distinct wave lengths in each of the nine districts are available for distribution by local inspectors. Three or four wave lengths will be reserved for the best of the local stations in this class, with no immediate adjoining districts having a station operating on a wave of the same length.

By this plan it is believed much interference may be eliminated.

A recent survey of the broadcasting stations show that the Mississippi River basin states have the largest number of stations, with the states of Michigan, Ohio, and West Virginia, together with New York and Pennsylvania, running a close second.

In a recent letter to all radio inspectors, Mr. Hoover points out that all broadcasters must adhere to the new individual waves assigned them, if interference is to be eliminated. Any violation of the reallocation plan of May 15, may result in the suspension of or revocation of license, as provided in Section 2, Act of August 13, 1912.

Beginning May 15, radio inspectors were instructed to carefully check the transmitting wave lengths of stations as far as practicable.

It is highly imperative that the transmitting stations adhere to the waves assigned to them as only careful execution of the plan will result in its success.

Some new regulations and amendments have been passed which provide that limited commercial stations are not open to public service and are licensed for a specific commercial service or services defined in the license. Stations of this class must not transmit to or accept public messages from other stations. No rates are authorized.

Licenses of this class are required for all transmitting radio stations used for broadcasting news, music, lectures, church services, government reports, and such matters, and do not permit the transmission of private or commercial communications.

Broadcasting stations must be operated by or under the supervision of an operator holding a commercial second class license or higher, such operator must be on duty during the entire time the station is being operated.

No testing or experimenting is authorized in broadcasting stations between the hours of 10 a. m. and midnight, local standard time.

Broadcasting stations, the operation of which interferes with the reception of time signals and meteorological signals must remain silent while the signals from such stations are being transmitted.

The reading of telegrams or letters by broadcasting stations will not be construed as point to point communication so long as the signer is not addressed in person and so long as the text matter is of general interest.

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RADIO OUTFIT AND SUPPLIES

Radio Solder for construction and repairing radio outfits. Three six inch bars 25c postpaid. Hamilton Lead Company, Hamilton, Ohio.

Officers Form Club

The United Service Radio Association was formally organized at the Army and Navy Club in Washington recently by a group of officers from the Army, Navy and other uniformed services of the Government. This club has for its objective the education of commissioned officers in the radio art and the fostering of radio development, through lectures and experiments.

A lecture course by experts on radio was planned following the first practical talk given by Maj. Gen. Geo. O. Squier of the Signal Corps, a member of the association. To date about one hundred officers have joined, including some civilian experts admitted as associate members. At the second session, Capt. J. T. Tompkins spoke on the use of radio in the Navy. The next meeting on May 7 will take place in a government radio laboratory where demonstrations of new radio sets will be made by Major Bender of the Signal Corps.

Officers of the Association are Lt. Col. F. P. Jackson, Q. M. C. President; Captain J. T. Tompkins, USN, Vice President; and Capt. R. B. Connor, USA, Secretary.

The Easy Course in Home Radio

Edited and Approved by Major General George O. Squier, Chief of the Signal Corps, U. S. A.

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Big New Stations

Plans are nearing completion for the erection of two more giant radio broadcasting stations by the General Electric Company, according to an announcement recently made by Martin P. Rice, director of broadcasting for that company

One of the new stations will be located near San Francisco and the other is indefinitely placed at somewhere between the Pacific and Atlantic Coasts. Both will be modeled after General Electric Company station WGY at Schenectady, N. Y., and the experience gained by the engineers in this station, after fourteen months operation, will aid greatly in the plans to give radio listeners in other parts of the country a radio service of the highest transmission quality.

Mr. Rice recently returned from the coast after a tour of inspection. He was accompanied by Harry Sadenwater, engineer in charge of the technical operation of General Electric Company radio broadcasting stations. Sites were investigated in and near Oakland and San Francisco, Cal., in Denver, Colorado and Dallas, Texas.

In each city visited, Mr. Rice received assurance of co-operation from the chamber of commerce and municipal officials who were alive to the advantages and prestige which may accrue to the city which is the home of a powerful broadcasting station.

The expansion of radio broadcasting by the General Electric Company from one to three stations is part of program agreed upon sometime ago by the General Electric Company, the Radio Corporation of America and the Westinghouse Electric. This plan contemplates the erection of nine large broadcasting stations. Of this number the Westinghouse has now three in operation, those at Pittsburgh, Pa., Chicago, Ill., and Springfield, Mass. The Radio Corporation has two stations under construction, one in New York and the other in Washington D. C. The New York station is on top of the Aeolian Building on 42nd Street and will be opened in a short time. The General Electric Company now operates WCY at Schenectady, N. Y., and will have a second station near San Francisco and a third somewhere between the Pacific coast and Schenectady, N. Y.

In discussing the plans of the General Electric Company, Mr. Rice said: "It is our conviction that the future of radio broadcasting will be on a plane of relationship with localized stations similar to that of the national magazine to the local newspapers. Each will have its own functions—the local stations to carry events of local interest and larger and more powerful stations to transmit events of national import and interest."

In Great Britain

Recent developments in England indicate that a strong effort soon will be made to relieve the amateur radio operator in that country from having to pay a proposed increase in license and buy his apparatus from the British Broadcasting Company. Radical steps to break the alleged monopoly are predicted, although they may not remove the bar against foreign manufactured radio telephone sets. If development is to be permitted, the whole situation must be simplified, many believe.

The new Postmaster General is said not to be especially sympathetic toward the present arrangement, but it is felt he will insist that apparatus be of United Kingdom manufacture. Many fans in Great Britain want to make their own receiving sets and utilize some manufactured parts. Today these radio fans can only secure an experimenter's license, but after receiving their permits they can use any kind of a set or part they desire, and listen in on all stations. These licenses, it is reported, remove them from the control of the British Broadcasting Company. It is assumed that they are engaged in experimental work but they undoubtedly listen in on all broadcasting concerts.

The Radio Manufacturers' Association has suggesed abandoning of the present method of securing revenue for the broadcasting company by license fees and royalties, and collecting the amount necessary for adequate revenue from the license fee. Restrictions against the so-called "pirate" would then be tightened.

According to a statement in Parliament, 35,383 experimental licenses have been issued, while as many more applications are on file. It is estimated that 200,000 individuals are using sets without licenses because they cannot secure the licenses they desire.

Radio on the Farm

(*Continued from page 16*)

tell him. We often get the stock markets before our local buyers get them.

Start With a Simple Set.

"It is not only interesting but very educational. We get some wonderful lectures and sermons we would not otherwise be able to enjoy. On bad days and nights we can sit around our own home fire and hear from the radio horn almost any kind of entertainment we choose.

"To those who are interested in radio I would say that if you have any mechanical ability you can buy all of the parts and assemble your set much cheaper than buying one ready-made. There are several good makes on the market that are very reasonable in price. I would suggest getting a vacuum tube set. The detector sets with head phones are very satisfactory but we like the amplifier and horn best. Any one can get the detector first, and then if further interested can add the amplifier and horn later.

"A neighbor boy made a set from paste board boxes and did all of his own work, including winding the spools, etc. His set cost him, including batteries, $35. He gets very fine results and hears all the stations that any one else gets, including Havana, Cuba, Denver, Col., etc.

Uses Flashlight Battery Set

A compact, self-contained portable radio receiving set, which can be carried as easily as a suit case, which requires only flashlight batteries for the filaments of the tubes and which weighs less than 18 pounds, has been perfected by the General Electric Company. An outstanding feature of this set, adding to its portability and desirability for camping trips, is the fact that the new radiotrons, UV-199, are used, which require only 60 milliamperes (.06 amperes) filament current per tube.

This new outfit will receive radio messages over a range from 200 to 600 meters for a distance as great as any set having a detector and one stage of amplification. It is housed in a mahogany cabinet with hinged front and rear covers. Head telephones with plug attached are clamped on the inside of the front cover. Provision is made in the rear cover for batteries that can be easily exchanged.

The set is so designed as to make a neat appearance in the home. The front cover can be easily detached.

The outfit comprises a regenerative receiver with a vacuum tube detector and one stage of audio frequency amplification. The circuit is very efficient and will operate a loud speaker on signals received from nearby stations. With an additional amplifier, it can be used to obtain loud speaker signals from distant stations.

For portable use the filament current is supplied from two 3-cell, 4 1-2 volt flashlight batteries in parallel, and the plate or "B" battery current is supplied by two 22 1-2 volt batteries connected in series. For home use, when weight and portability are not essential, larger batteries both for filament and plate current can be used. For such use it is recommended that three 1 1-2 volt dry cells in series be used for the filament and two larger size 22 1-2 volt batteries in series be used for the plate voltage.

In Ireland

No definite policy has been announced by the Irish government up to April 1 regarding its position with respect to wireless broadcasting, or the operation of private receiving sets. There is a small market for this class of equipment, which, since the regulations of the British post office and the British Broadcasting Company do not apply in Ireland, is open to foreign manufacturers.

Foreign Languages

Schools in Sheffield, England, recently had the privilege of listening to French prose and poetry broadcast from a French radio station. The director general of the French radio service consented to cooperate with F. Lloyd, President of the Sheffield District Wireless Society, in an effort to provide for foreign language students the broadcasting of standard and classical foreign literature. It is hoped that this firsthand instruction can be extended to include the broadcasting of English, German, Italian and Spanish language lessons.

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Every "Skipper" His Own Forecaster

Within a short time, skippers of ocean-going vessels equipped with radio, will be making their own forecasts and weather maps daily, according to Chief Forecaster Edward H. Bowie, of the United States Weather Bureau. This is due primarily to efficient and immediate radio service.

Since his return from a long trip on the Atlantic Ocean in the French ship, Jacques Cartier, Mr. Bowie is very enthusiastic over the prospects of forecasting at sea, and urges its practice on American vessels. With the vast amount of meterological information broadcast today from practically all large radio stations, and many ships, it is possible, he says, for the ship masters to make their own forecasts and even make a daily plot of weather conditions, just as is done in the weather bureau in Washington. The Naval Radio station at Arlington sends out a general report daily from North America and in return receives a similar report from Paris on European conditions.

Since most storms journey eastward, a skipper in the Atlantic generally knows what is coming and by keeping in touch with vessels west of him he can do his own forecasting. In turn, he keeps other ships posted as to conditions in his location, and by cooperation many floating weather bureaus eventually will benefit each other and the countries with which they are in touch.

Several new radio stations to transmit weather information from the north of this country now are planned, Mr. Bowie stated, one at Cape Farewell in Greenland, three in MacKenzie Valley, Canada, and one on Baffin Island.

"Radio has done wonderful things for meterology," Mr. Bowie said. "In the old days we issued statements, ran up storm warnings on the coasts and had to let that suffice, whereas today we broadcast everything and ships at sea are as well informed as shore stations."

Special Licenses

In an effort to encourage the scientific development of broadcasting and apparatus for that purpose, the Department of Commerce has created a new form of special license known as the "Broadcasting Development Class." Licenses in this class will be issued to station owners having transmitting and receiving sets of their own design and manufacture, provided in duplicate where failure is likely to occur. These stations are to be used for the improvement of broadcasting and many special requirements are demanded by the Commerce Department, which will furnish detailed information upon application.

Send $1.00 to Radio Age, 64 Randolph Street, Chicago, and receive this middle-west radio periodical for six months. Regular subscription price is $2.50 a year.

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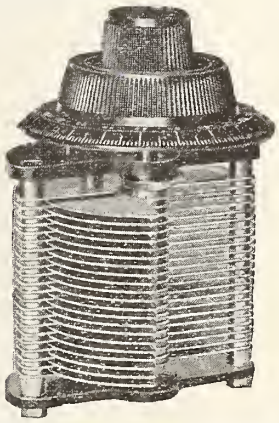
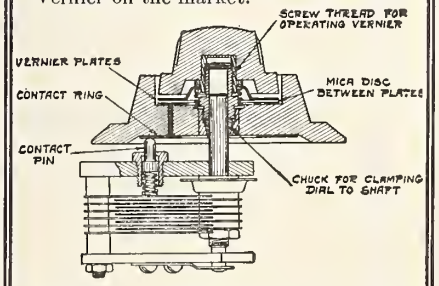


United Variable Condensers have a wonderful new patented **Vernier Dial Assembly,** which makes possible twice as fine adjustment as any three plate Vernier on the market.



43 plate	$6.50	5 plate	$5.00
23 plate	6.00	3 plate	4.75
11 plate	5.50	Postpaid	

Vernier alone can be attached to any plate condenser by drilling 1 hole, **$2.50**

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SERVICE DEPARTMENT FOR READERS

Please remember that Radio Age has one of the best radio instructors in the United States, who is ready to answer any technical question. This costs subscribers nothing.

Use of Rubber in Radio

(*Continued from page 17.*)

the set is responsible for a good share of the losses that occur in the receiver. At comparatively low frequencies chemically compounded materials are about on a par with hard rubber in this respect. But at radio frequencies these figures are not at all applicable, for a new phase of the insulator's structure becomes predominant. The leakage in the compounded insulators increases considerably, and the reason which has been advanced is that the structure consists of solid substance in which are microscopic pockets containing more highly conductive material. These pockets act as a series of tiny condensers that at high frequencies form a convenient leakage path."

Workability of Hard Rubber.

The workable qualities of hard rubber give it a distinct advantage over any other insulating sheet material used for panels. It may be machined, drilled, cut, threaded, engraved, stamped, sanded, and polished with ordinary tools without danger of chipping.

In large scale factory operations hard rubber is cut with power circular saws of special design. In panel making and similar work satisfactory results . are obtainable by using for cutting to dimensions an ordinary hack saw with blade having 24 teeth to the inch. For drilling holes use a straight fluted drill, feeding slowly without great pressure, otherwise the stock may heat excessively and the drill run the hole out of true.

Radio Parts from Sheet Stock.

Among the radio instrument parts that may be fashioned easily from hard rubber sheet may be mentioned condenser ends, slider blocks, spider web and honeycomb coil mountings, parts for phone plugs, detector bases, variocouplers, tube sockets, dials, knobs, and condenser boxes. Variometer tubes can be cut from stock hard rubber tubing, and various pieces and handles can be turned from hard rubber rods.

Hard rubber is no doubt at once the cheapest and best radio panel material and meets with favor because of these points and the facility with which it can be machined. Where volume production in molded pieces is concerned the advantage of cheapness lies with the various hard molded plastic compositions. It is safe to say that when special parts are needed or highest quality desired hard rubber alone should be used.

Molded Hard Rubber Parts.

Hard rubber can be molded into any form in iron or steel molds under hydraulic pressure or in soft metal molds made from a steel matrix. Iron and steel molds are preferable as the molds are more permanent and retain their shape, producing a more uniform article. It is easily worked into special designs either by molding or machining and takes an excellent finish.

A hard rubber molded part of widely extended utility is the case and cap of the telephone receiver. In this application hard rubber is particularly valuable owing to the accuracy with which it can be machined and also to its remarkable sonorescent quality.

Other hard rubber molded pieces used in radio instrument construction are variometer tubes, and frames, condenser bases and tops, slider blocks, spider-web and honey-comb coil mountings, parts for pone plugs,detector and induction coil bases, and a variety of other irregular shapes of specialdesign.

The variometer case is molded in two pieces. These are accurately formed to fit together closely without machinery other than boring bolt holes. The variometer rotor is molded in one piece of suitable size to revolve within the two-piece case. Variometer tubing is made of one-ply hard rubber calendered sheet formed around a mandrel, the edges of the raw stock being united by knitting together the skived edges. Hard rubber tubes and rods are packed in soapstone for curing in open steam. Vacuum tube sockets are made in a multi-cavity steel mold, as are also the B battery box and its perforated cover pieces, also the condenser case or small single piece box with end flanges designed to contain the parts of a fixed condenser.

Condenser ends are made by sawing thin hard rubber sheet into suitable size and dimensions. Dial knobs with graduated dial are molded from steel molds hobbed or engraved to show the dial graduation cut into the finished surface of the dial. The graduation and figures are given distinctness by filling them with white lead paste.

Several of the molded parts named are shown in the illustration. Among those represented the panel and variometer tube are not molded but are made from calendered sheet stock.

Standard Panels.

Hard rubber panels are sawed from vulcanized sheet, the standard size of which is 20 by 48 inches made in bright-tin finish, which is secured by vulcanization between planished sheets of tin. Panels for radio receiving sets should be true, square cut, and edges ground true.

Following are the usual stock sizes of 3-16 inch hard rubber panels for the amateur builder of receiving sets.

7 x 10	7 x 24
7 x 14	10 x 12
7 x 18	12 x 14
7 x 20	12 x 18

Simple Tests for Hard Rubber Quality.

Hard rubber is made in many grades and the quality can be easily judged by the toughness of the shaving and by the facility with which it cuts and machines. The easier it machines the better the quality and the more readily it takes a black high polish.

As interest grows in radio reception from far distant stations, and the application of the theory of radio frequency becomes correspondingly more general, the importance of protecting all apparatus against slight leaks and losses, due to ineffective insulation, is more and more appreciated. This condition will gradually bring about the use of panels, dials, and other parts having smooth polished surfaces free from small pits and furrows, and having unusual freedom from inherent and surface moisture.

Use of Kilocycles

The Second National Radio Conference, which met with Secretary Hoover in March, introduced a method of designating radio waves which is somewhat new to the radio public. This is the use of frequency in kilocycles (abbreviated kc) instead of wave length in meters. The advantages of this practice have been familiar to radio engineers for some time, and it is probable that it will eventually replace the use of wave length in meters. As a matter of fact, wave length is a somewhat artificial conception in the handling of radio apparatus and is one of the difficult things for the beginner to understand. The frequency of the radio wave is the same as the frequency of the alternating current which flows in the radio transmitting or receiving set.

As often happens in technical matters, the idea of "kilocycles" is simpler than the forbidding aspect of the word suggests. "Kilo" means a thousand, and "cycle" means one complete alternation. The number of kilocycles indicates the number of thousands of times that the rapidly alternating current repeats its flow in either direction in the antenna in one second. The smaller the wave length in meters, the larger is the frequency in kilocycles.

The reason that kilocycles are coming into use and displacing meters is that the necessary separation of the frequency of transmitting stations to prevent interference is the same, no matter what the frequency may be. This neccssary separation is variable and quite misleading when expressed in meters. Thus the number of radio messages that can be transmitted simultaneously without interference can be correctly judged from the kilocycles but not from the meters. For example, the amateurs will in the future work in a band of wave lengths from 150 to 200 meters, but this is a frequency band from 2000 to 1500 kilocycles. This is an enormously wider band when considered from the viewpoint of kilocycles than, for example, the band having the same width in meters from 1000 to 1050 meters, which is 300 to 286 kilocycles. While it is possible to carry on fifty simultaneous radio telephone communications between 150 and 200 meters, only one could be carried on between 1000 and 1050 meters.

In accordance with the recommendation of the Second National Radio Conference the Department of Commerce and other Government departments will hereafter follow the practice of specifying in even values of kilocycles rather than meters. The Conference recommended the practice of expressing wave frequency in kilocycles per second with wave length in meters in parentheses thereafter. The relation between the two is very simple. To obtain kilocycles, divide 300,000 by the number of meters; to obtain meters, divide 300,000 by the number of kilocycles. For example, 100 meters = approximately 3000 kilocycles, 300 meters = 1000 kilocycles, 1000 meters = 300 kilocycles, 3000 meters = 100 kilocycles.

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Atlas Head Phones

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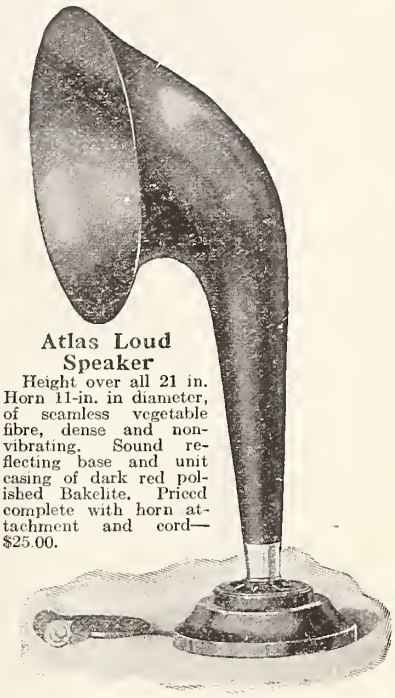

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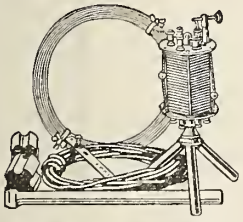
The Atlas Gives Tone Volume With Perfect Tone Control



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Multiplied enjoyment with your radio follows the use of a loud speaker which, set in any convenient spot, throws out the tones so that a roomful of family and friends can hear.

But in selecting the loud speaker, bear in mind that loudness without clearness is mere noise—and get an ATLAS.

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JULY, 1923

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Hook-ups and Pick-ups

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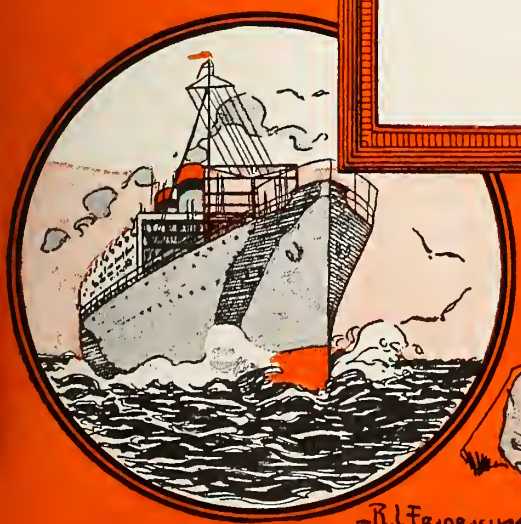
Many Good Circuits!



R. L. Freeman

OFFICIAL NEWS MEDIUM FOR NATIONAL BROADCASTERS' LEAGUE

Reinartz Radio

How to make this distance wrecker.
How to amplify it.
How to make a Reinartz panel.

With Hook-ups

Written and Illustrated by
FRANK D. PEARNE
Chief Instructor in electricity at Lane Technical High School, Chicago, and famous writer on radio construction and operation.

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RADIO AGE

The Magazine of the Hour

Volume 2 *JULY, 1923* *Number 6*

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Radio "Pirates"

THIS magazine, from the first, has insisted that no publication, individual or corporation that favors turning radio merchandise, radio manufacturing and radio broadcasting over to a monopoly can by any perversion of logic be called a friend of radio.

There should be no monopoly in tubes, sets or broadcasting stations. There should be no special privileges. There should be no patience with efforts to establish monopoly through incessant patent suits against the weaker fellows.

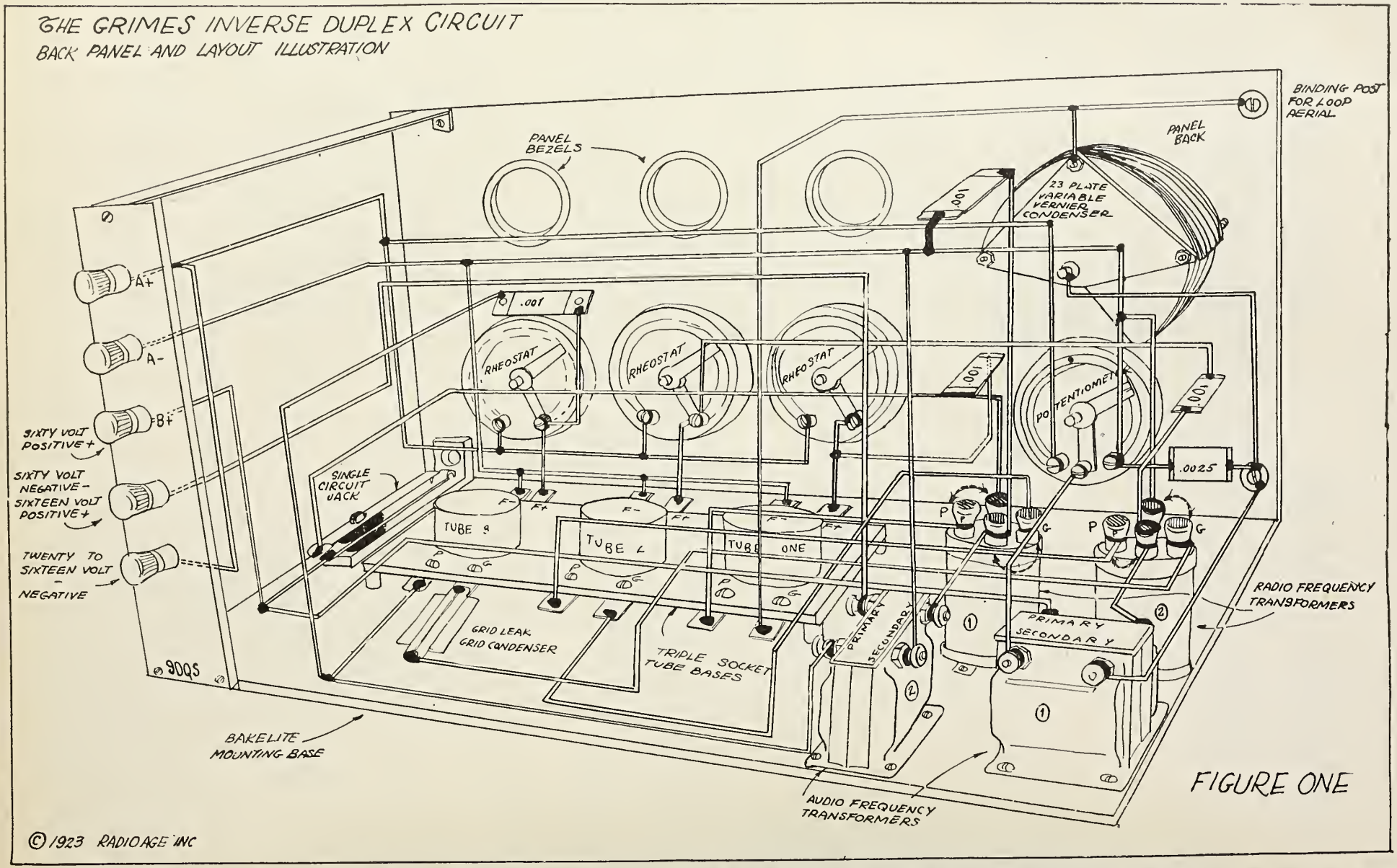
Radio belongs to the millions and not to a few big corporations. It cannot be cornered like wheat or Stutz stock. It cannot be manhandled by Congress. It cannot be made a football of politics.

If there be any reader who doubts the truth of the foregoing statements let him observe what has transpired in England, where the government turned radio over to a monopoly and attempted to prevent by law the operation of receiving sets, unless a license was paid. Two hundred thousand English "pirates" are laughing at the government today and going right along listening in without licenses. The British government is up a stump.

The English monopolists have discovered, what we have contended was self-evident from the beginning: Radio IS the public. Its regulation will be governed by the public. The American Society of Composers, Authors and Publishers attempted to prevent the broadcasting of copyright music without the payment of a tax to the Society. We know of no broadcasting station that is paying such a tax. If you wish to hear copyrighted music tune in on almost any station in the country. The Society does not appear to be doing so well.

By the time the monoploy-seekers have hog-tied radio, birds will have stopped singing and sunshine will be sold to the consumer at so much per cubic yard.

—The Editor.



Drawing of the layout and wiring of the Grimes Inverse Duplex Circuit. The arrows on the radio frequency transformers indicate the two binding posts terminating the beginning and ends of the transformer coils.

RADIO AGE
"The Magazine of the Hour"
M. B. SMITH, PUBLISHER
PUBLISHED MONTHLY
FREDERICK SMITH, EDITOR

The Grimes Inverse Duplex System

By FRANK D. PEARNE

PERHAPS no circuit, since the days of the Armstrong super-regenerative system, has attracted so much attention as the Grimes Inverse Duplex. The name, "Inverse Duplex," applied to this new arrangement by the inventor, Mr. David H. Grimes, has a rather foreboding sound to the timid amateur, but, nevertheless, it has looked inviting enough to engage the attention of thousands of enthusiastic fans all over the United States, and the different reports received are indeed interesting.

This circuit is nothing more or less than a combination of radio frequency, detector, and audio frequency amplification cleverly arranged, so that each tube used will do the work of two. In other words, the tubes amplify at both radio and audio frequency simultaneously without overloading them. The greatest difficulty experienced in the ordinary reflex circuit is caused by some of the tubes doing more than their share of the work, and the others not being worked to their full capacity. Mr. Grimes has so arranged his circuit that the work is more evenly divided among the tubes, each carrying about the same load, those carrying the heaviest audio frequency load where the lightest radio frequency currents are passing.

In the beginning I will say that this is no circuit for the really green amateur to attempt to master. Any radio frequency circuits, and especially those of a reflex circuit, are complicated, to say the least, and it will require much patience and experimenting before the set can be pronounced perfect. In the description given in this article I have tried to give the prospective builder the benefit of much experimenting and experience of those who have worked it out with different types of transformers and different condenser values, so that some of the difficulties experienced by them will not have to be overcome by our readers.

The "Inverse Duplex" when properly constructed will have a wonderful range when used with a small loop aerial. Distances of 2,000 miles have been covered with a three-foot loop aerial, according to reports received, but unless the greatest care and patience are exercised in its construction, it will be found quite difficult to control.

Figure 1 is an isometric drawing of the rear of the panel and base. In order that the circuit and parts may be easily traced these parts are shown spread out over considerable space, but in practice they must be mounted close together so that all connecting wires will be as short as possible. Every inch that can be cut off the wires connecting the different parts will greatly add to the efficiency.

The reason for this is the fact that these wires and parts are all carrying high frequency currents and if the wires are long, or run too close together, they are very apt to affect each other on account of their capacity.

All parts such as transformers, sockets, condensers, etc., must be mounted on a bakelite or hard rubber base. This may sound peculiar to the fan, but any slight leakage between the parts will give no end of trouble, and it has been found that a wooden base contains enough moisture to cause considerable leakage. The fixed condensers shown should be mounted directly on the transformer terminals if possible.

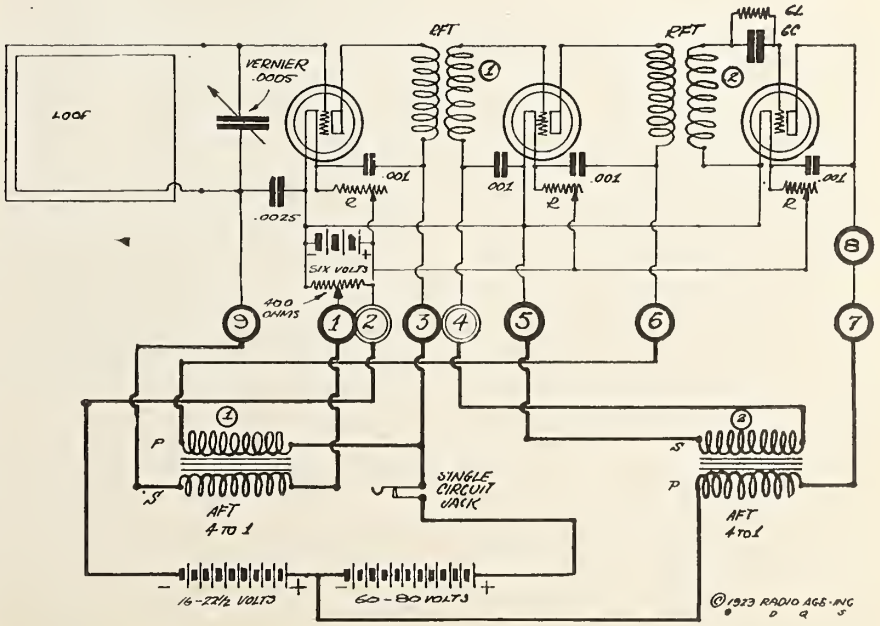


Figure 3. Circuit diagram showing the radio frequency component of the Grimes circuit in lighter lines, with the heavier lines representing the addition of the audio frequency. The numbers refer to the connections for use when the radio frequency part is connected up as provided for in the text.

One of the greatest troubles experienced in radio frequency or reflex work is the tendency of the tubes to oscillate and howl.

Even though radio frequency transformers are very carefully designed and constructed, they cannot be made to give the same results on one type of tube that they will give on another, consequently a particular tube must be decided upon, and the particular radio frequency transformer which works best with it, should be used. The Acme transformers were used in the set described when UV-201A amplifying tubes were used in combination with a UV-200 detector. This combination has been found to work best, while with other types of tubes, other makes of transformers seem to give better results. This does not mean that this particular type of transformer is better than the others, but merely that this arrangement gives a happy combination which works very well.

In order that the construction may proceed step by step, and a check up of the conditions may be made as the work advances, the radio frequency part of the circuit should first be connected up and tested. When this part of the circuit is wired up and found to work, then the audio frequency part may be added, but it would be useless to add the audio frequency until this part is found to function properly.

To aid the builder in this test, Figure 3 is shown. It will be noticed that the arrangement for making each tube do the same amount of work makes a circuit somewhat different from an ordinary radio frequency circuit. The upper part of Figure 3 (shown in light lines) represents the radio frequency component of the circuit. In order that it may be tested as straight radio frequency first, we must temporarily forget about the lower part of the drawing (shown in heavy lines) and make temporary connections as follows: No. 9 to No. 1, No. 2 to negative "B" battery, No. 3 and No. 6 to the 80 volt positive terminal of the "B" battery, and No. 4 to No. 5. No. 7 is connected directly to the 22½ volt terminal (positive) of the B battery, and the phones are placed between No. 7 and No. 8. These numbers are shown in the circles in the center of Figure 3.

Remember that during this test, these numbers simply represent the terminals of the wires from the radio frequency component and that none of the wires represented by the heavy lines has as yet been put into the set. When the connections have been made as described, place a UV-200 detector tube in the last socket (to the right of drawing) and a UV-201A in each of the other sockets. This is now an ordinary radio frequency circuit, composed of two steps of radio frequency and a detector. This should now be tried out and if signals come in well, it may be assumed that this much of the circuit is O. K.

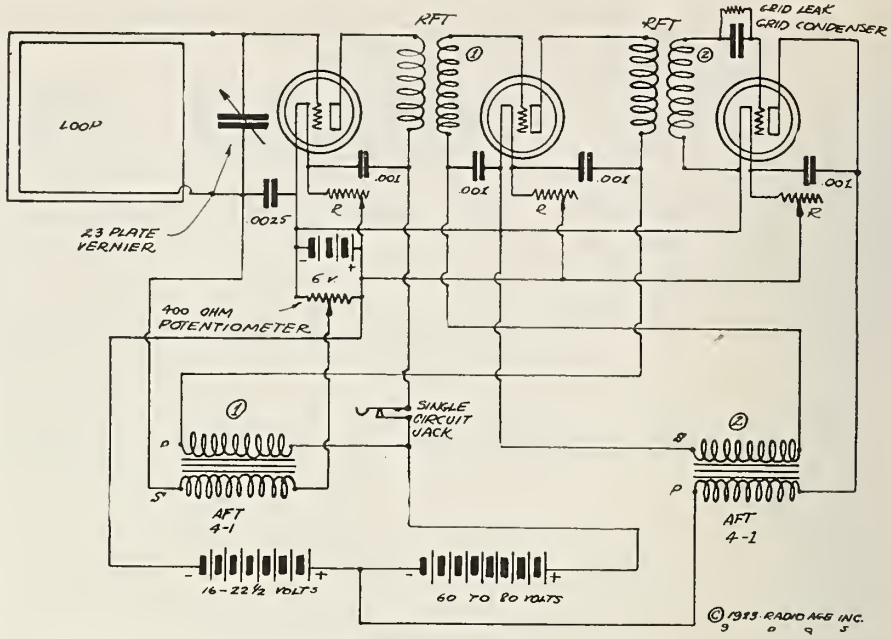


Figure 2. The finished hookup of the Grimes Circuit.

Before making this test, or in fact, before connecting up the "B" battery, each of the .001 fixed condensers should be tested with a buzzer to prove that they are not short circuited. If no buzz is obtained then they are all right and the "B" battery may be connected. The condenser which is connected across the terminals No. 4 and No. 5 will give a buzz when tested, as this is shorted by the connection between these terminals, but all the others must test clear, or the filaments will be burned out by the B battery current getting through them.

After testing the radio frequency circuit and it is found to function, then the temporary connections are all disconnected and the audio frequency component is added. This is plainly shown in Figure 2, which is a duplicate of Figure 3 with the exception of the numbering system used for the temporary connections. In connecting up the radio frequency transformers, the terminal marked "P" should go to the plate terminal on the socket, and the terminal marked "G" must be connected to the grid of the next socket as shown. However the proper connections to the audio frequency transformers may require some experimenting as to the direction in which these currents pass through. This merely means that the two connections on either the primary or secondary coils may have to be reversed, but they must not be changed from one coil to another.

The principal requirement in the building of this set is plenty of time and patience. Much howling and squealing will be encountered until one learns just how to adjust the set. This can usually be remedied by turning down the rheostats on the amplifying tubes, but one will soon learn just how to take care of this.

All connections must be soldered carefully, and if paste is used as a flux, it should be wiped off with a little alcohol after soldering. Most any kind of a loop will work well with the set, but to get the best results a loop 16 to 18 inches across each side is recommended. This should be wound with from 8 to 12 turns of wire, spaced about ¼ of an inch apart. Either solid or stranded wire may be used. No. 18 wire is very good, but single strand lamp cord affords a much more flexible winding. The exact number of turns must be found by experiment, but the number will be somewhere between 8 and 12. Of course the smaller the loop, the less energy it will pick up, but results have been obtained even on a 4 inch coil, such as is used for the primary winding of a variocoupler.

Send $1 to Radio Age, 500 North Dearborn Street, Chicago, and receive this leading hook-up guide for six months. Regular subscription price, $2.00 a year.

Hookups and How to Read Them

By Felix Anderson

Radio 9 D Q S

THERE is probably no more disconcerting incident in the career of an embryo BCL than the fact that with his initiation into the radio game he is expected to be able to understand a great many symbols, signs and diagrams. Usually, when he casually asks for information on the construction and wiring of a set, he is presented with a circuit diagram, more commonly dubbed "hookup," which to him is a meaningless lot of symbols and signs on a piece of paper, which may be about as clear as a lot of Egyptian heiroglyphics would be to the average enthusiast who has become familiar with the reading and execution of the circuit diagrams.

No doubt there would be less confusion and trouble in hooking up sets, if working drawings were used to portray different circuits. Each set is usually hooked up in an individual manner, and should error occur, there is a great deal of time and trouble expended in locating the error or incorrect connection.

A radio expert will very seldom evince much interest in the set you are using, if you show him a photograph of the layout and ask him to point out your error; but show him a concise diagram of the circuit, as you have connected it, using the correct symbols, and you will immediately notice a change in his attitude, and also the ease and quickness with which he detects faulty construction. The advantages of using a system of signs and symbols for portraying our ideas in connecting up sets and showing various circuits is readily seen.

With the idea of admitting the newcomer into the mysteries of the radio pastime, the writer has compiled a chart of symbols which are used commonly in the course of construction, correction and design of present day radio systems. It is hoped that the reader will look over them, and should the occasion arise, make use of them in his queries and suggestions.

Starting in the upper left-hand corner of the page of symbols, the conventional symbol for the antenna is shown. The symbol does not limit the size, type or kind of antenna in the least; it is merely used to designate that an antenna is used in a circuit, and its relation to other parts of the radio system. The same applies to the ground, which is represented by a heavy bar, with several lighter lines underlying.

Lofty tower of the famous Station WJZ in its new home on Forty-second street, New York, between Fifth and Sixth Avenue. (U&U Foto).

Each symbol seems to suggest its own interpretation, much as does Indian writing. In the case of the ground, the ground symbol pictured gives the impression of the black bar being the top soil and the underlying lines a sort of cross section of the underlying soil.

A counterpoise system is next symbolized. The counterpoise, although heretofore exclusively used for transmitting purposes, is rapidly gaining in favor with fans who find that the ground connections they are accustomed to use are inefficient and are poor conductors. It is merely another antenna system, similar to the one used as the receptor, connected to the set in lieu of the ground.

The symbol of the loop antenna is next shown. Connections are made to the free ends of the wires as indicated in the illustration.

Referring to the illustration of the two-slide tuning coil, it is easily explained that a coil of wire us usually indicated in a diagram by the use of a series of loops in a continuous string. This coil is also called an inductance. The two arrows indicate that there are two sliding or similar arrangements, which provide a means for increasing or decreasing the number of turns used in the circuit. This variation can be accomplished either by the use of sliders or taps. Sometimes a tapped inductance is indicated as in the symbol for the tapped coil. The type of circuit, and the design of the set govern the use of either taps or sliders.

Connections of wires and instruments are usually indicated by a dot, and the non-connection where lines cross each other in a circuit diagram is indicated by a small hump, inferring that the wire is jumped and not joined. Binding posts where designated are indicated by a small circle.

Batteries, of all voltages and types, are usually shown by the use of a long light line, followed by a shorter, heavier line, running immediately parallel to each other. The long line should be marked plus or positive, while the shorter, heavier line is termed the minus or negative.

A choke coil, commonly used by the average enthusiast, is designated by a series of parallel lines, encircled by a series of lines indicating the wire, the parallel lines showing that a core of soft iron was used, around which the wire is wound.

The variocoupler or loose coupler is probably one of the most widely used and most popular forms of tun-

ing systems now in use. Its presence in a circuit is shown by the symbol consisting of two spiral lines parallel to each other, the one in this case to the right being the primary and the other the secondary. In the illustration provision is made for two methods of varying the amount of wire in use, the proper connections for this being shown under variocoupler connections. If a coupler is used having more than seven taps, it is customary to provide two sets of switch taps, connecting them as shown. However, if there are only seven or less taps on the outer coil, they are connected by using only one switch, and taking the beginning wire, or top wire, and connecting it to the antenna, the rest going to switch-points, and the switch going to the ground.

A variometer consists of two coils of wire connected in series as shown and is indicated in the circuit by a similar sign. Honeycomb coils being nothing more than a coil of wire, or inductance, are indicated by the usual sign for an inductance as in B. Sometimes they are shown in circuits by the symbol A.

Resistances in circuits are practically always indicated by a jagged line, showing that that particular instrument is noninductive: i. e., does not transfer any energy to another part of the circuit by the induction phenomena.

A small, blunt-headed arrow, and sometimes a thin, curled line, is used to portray the crystal detector, as shown in the chart. Meters, whether volt, galvanometer, ammeter or milliameters, are indicated by a circle, as shown. The lines on either side indicate the connecting wires.

The grid leak, as shown, is a form of resistance, a very high one, indeed, and its unit of measure is usually called a Megohm. This term means one million ohms. Its construction is described elsewhere in this issue.

Condensers, one of the most important instruments in radio, are indicated by two heavy parallel lines as shown. An arrow drawn through its center conveys the idea that it is variable. Audio frequency condensers are indicated somewhat differently. A condenser, it is understood, consists of two parallel conducting mediums, separated by a dielectric substance. The insulating material may be air, glass, mica or oil.

Transformers, being inductances, are indicated by the conventional symbol. In this case the radio frequency transformer, having no iron core, has no lines separating the coils. Connections on these transformers are usually marked G for grid, P for plate, B or plus (+) for the B battery, and F or minus (−) for the negative filament.

Jacks are indicated as shown, A being a two-circuit jack, while B is a single-circuit jack. They are used to plug in the headsets on detector, and first stages of multistage amplifiers, and are also used to change from phones to loud speaker. The plug when inserted to the jack pushes up the two springs, permitting the current to flow through the phones only, and opening the circuit for the remaining instruments.

The tube, its socket and its various circuits are next shown, in order that the reader may become familiar with its terms. G means the zigzag wire inside of the tube, F and F the filament from where the electrons, the secret of the vacuum tube, are emitted, and P the plate.

It should be remembered that nearly always a positive charge is sustained on the plate of the tube, as this is the base of its operation.

For the benefit of those who are not familiar with radio terms, an oscillatory circuit is shown, which consists of a condenser and inductance in series. There is also always present another unit in this circuit, resistance, which may be in the connecting wires, in the condenser or in the inductance.

Practically, the entire radio game is governed by the use of the so-called hookup, and an example is shown at the bottom of the chart. Due to the particular arrangement of the apparatus, this circuit is called the Armstrong regenerative circuit, deriving its name from its inventor, Major Armstrong. Because it has three permutations for tuning, it is sometimes called the three-circuit tuner.

Referring to the diagram, we notice that the antenna is connected to the primary or outer coil of the varicoupler through the switch and the taps, and also to the ground by another set of similar taps. It is through this coil the received impulses travel, and in the course of their travel are transferred to the secondary by induction. The set is tuned to their frequency by means of the variocoupler, and still further tuned by the use of the variometer as shown, in the "grid" circuit. Passing through the grid condenser, they are impressed on the grid of the tube, and produce a change in the plate voltage: the variation, being general, is detected in the telephone receivers placed in the plate circuit. A variometer placed in the plate circuit, enables us to make very weak signals audible, due to the fact that by its adjustment in relation to the rest of the circuit, a delicate balance can be effected.

The lines connecting the various symbols indicate the method used in wiring up the apparatus. The circuit diagram does not mean the apparatus must be arranged; it merely shows how these several instruments should be electrically joined.

It is hoped that many of our BCL (broadcast listener) friends may benefit by this chart, and may be more intelligently enabled to read and study diagrams as they appear in the course of their radio experiences.

Automatic Transmission and Reception

During the last ten years, commercial companies developed automatic printing telegraph equipment for the transmission overland wires of typewritten characters from one point to another. The present means of copying signals with the tape requires the employment of two or three extra men for translating purposes. Due to the reduction in operating personnel in the Naval Service, it became imperative to devise means to operate stations with reduced personnel. Experiments conducted in 1922 prove conclusively that automatic printing equipment could be applied to radio as well as to land wire. So much faith was placed in this new method of transmission and reception that automatic recording telegraph equipment has been installed in Naval high power circuits at San Diego, and Washington.

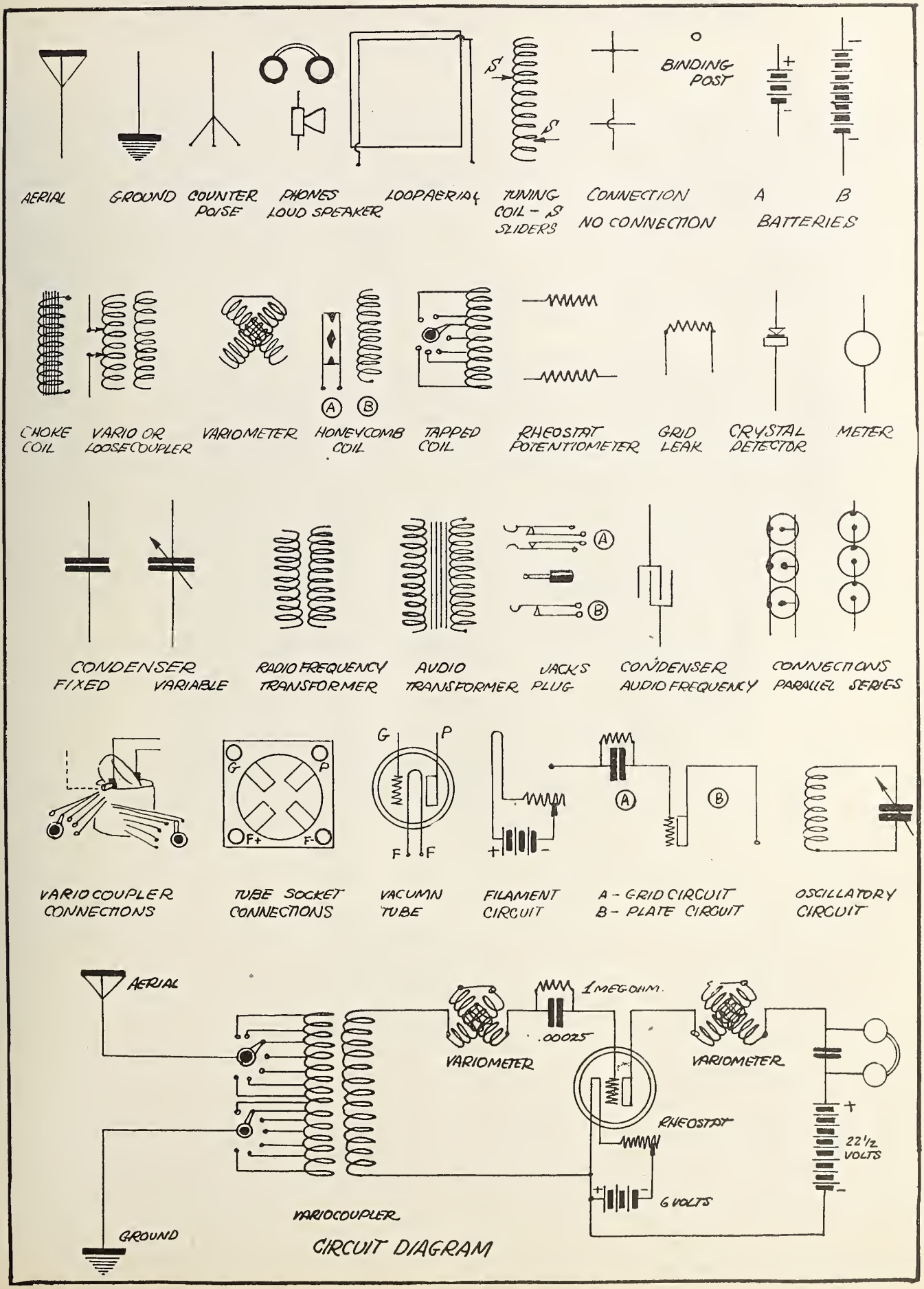
Ireland Gets WGY

That members of the Irish Constabulary are not always engaged in offensive or defensive operations with the Revolutionists is indicated by a letter recently received by WGY, the Schenectady station of the General Electric Company, from Harold Johnston Special Constable 11038, Ulster Special Constabulary of Barons-Court County Tyrons.

Constable Johnston wrote that he picked up WGY, February 24. "Your music was very loud and exceedingly clear," wrote Mr. Johnston, "especially the Radio Quartet and last of all the bells could be heard with phones one foot from ears. We are using a five valve receiver."

Invalids Like It

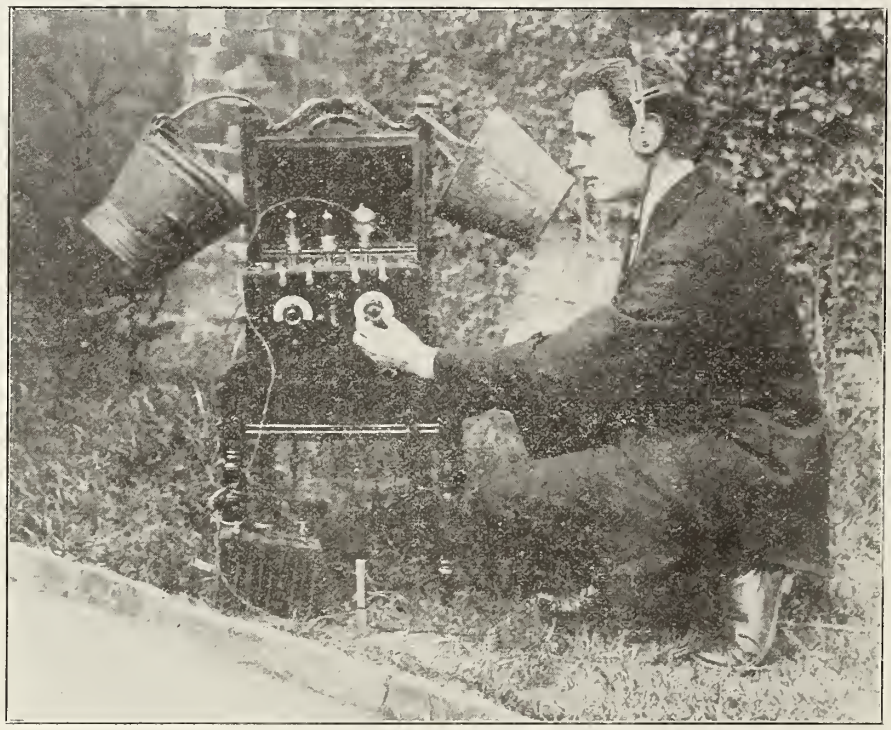
A letter signed "Patients of the Vermont Sanatorium," was recently received by WGY, acknowledging the pleasure and entertainment they get from the radio programs. The patients, sixty in number, are suffering from incipient tuberculosis and most of them depend upon WGY for the Sunday religious services. They wrote that they get the 7:45 p. m. concert but have to be tucked into bed at 8:30.


AERIAL
GROUND
COUNTER POISE
PHONES LOUD SPEAKER
LOOP AERIAL
TUNING COIL - S SLIDERS
S
S
CONNECTION
NO CONNECTION
BINDING POST
A
B
BATTERIES
CHOKE COIL
VARIO OR LOOSE COUPLER
VARIOMETER
HONEYCOMB COIL
A
B
TAPPED COIL
RHEOSTAT POTENTIOMETER
GRID LEAK
CRYSTAL DETECTOR
METER
CONDENSER FIXED VARIABLE
RADIO FREQUENCY TRANSFORMER
AUDIO TRANSFORMER
JACKS PLUG
A
B
CONDENSER AUDIO FREQUENCY
CONNECTIONS PARALLEL SERIES
VARIO COUPLER CONNECTIONS
G
P
F+
F-
TUBE SOCKET CONNECTIONS
G
P
F
F
VACUMN TUBE
FILAMENT CIRCUIT
A
B
A - GRID CIRCUIT
B - PLATE CIRCUIT
OSCILLATORY CIRCUIT
AERIAL
1 MEG OHM.
.00025
VARIOMETER
VARIOMETER
RHEOSTAT
22 1/2 VOLTS
6 VOLTS
VARIOCOUPLER
GROUND
CIRCUIT DIAGRAM

Proper Antenna for Tuning

By F. CONRAD
Assistant Chief Engineer, Westinghouse Electric & Manufacturing Company

THE ability to hear a desired station alone, or "selectivity" as it is called, depends in part on the receiving apparatus and in part on the antenna system to which it is connected. Many believe that the better the antenna, the better the signals. This is true, but it does not necessarily mean that the best antenna is the largest. The function of the antenna is to transfer to the receiving apparatus the electric forces which are set up by the waves being transmitted through space. This receiving apparatus must discriminate between the electric forces due to the radio wave it is desired to receive, and the forces due to the undesired waves, among which are the waves from "Dame Nature" herself, or "static" as they are called.



This fan, snapped in his garden in Sheffield, England, uses two tin pails as aerial and counterpoise. He easily picks up London and Manchester. (U&U Foto).

The selective receiver is one that offers a high resistance to the flow of current which would be set up by the electric forces from undesired waves, and offers a low resistance path for the flow of current due to the electric forces from the waves it is desired to receive. In other words, it permits you to hear the stations you wish to hear, and to tune out those you do not wish to hear.

The receptive ability of an antenna is, in general, determined by the height of its horizontal portion above the ground, or, stated differently, the strength of the electric forces induced in an antenna by the radio waves is proportional to the height of this antenna. Therefore, to tune out or discriminate between different waves, the selectivity or resisting power of the receiver to interfering waves would have to be increased as the antenna height is increased, while to receive an equal signal from a desired wave, the resistance in the receiving set to this desired wave, would have to be decreased as the antenna height is decreased.

Experiments have shown that when the antenna height is increased and a receiver, such as a crystal-detector set or a tube set not using regeneration, is used, the signal at first increases but soon reaches a maximum strength, which can not be exceeded by further increase of antenna height. This height is such that the electric forces set up by the incoming wave is sufficient to drive through the receiving apparatus the full current strength which is equivalent to the received signals. To express it in another way, this maximum current is that which would itself set up the same strength of radio wave around the receiving antenna as is induced by the transmitting antenna sending out the signals it is desired to hear.

A vacuum-tube receiving set, in which the principle of regeneration is employed, tends to reduce the resistance to the flow of current from a wave corresponding to that for which it is tuned. Therefore, if a regenerative receiver is used, it will be found possible to maintain the maximum strength of signal, even with a reduced antenna height. However, as the same resistance will be maintained by this receiver against undesired waves the reduction of height will therefore give a greater selectivity. Of course, in general practice it usually will not be possible to obtain quite the same strength of signal with the low as with the high antenna, as there is a certain amount of absorption or loss near the ground which tends to reduce the possible signal strength.

Should the location be such that the antenna is perfectly clear and free from surrounding objects, the low one will be found to be practically equal to the high one, when a regenerative receiver is used. But should the antenna be located where it is considerably shielded, as where it is surrounded by high buildings, it is possible that the signal strength will be greatly influenced by height. In this latter condition, it will probably be necessary to make up for the poor selectivity of the high antenna by using a somewhat elaborate receiving apparatus. Under the conditions surrounding the average residence district, it usually is possible, with care in the location of the antenna, to maintain good signals, even though the height is considerably less than with the scheme generally employed of attaching the horizontal wire to some point near or on the roof of a two-story house.

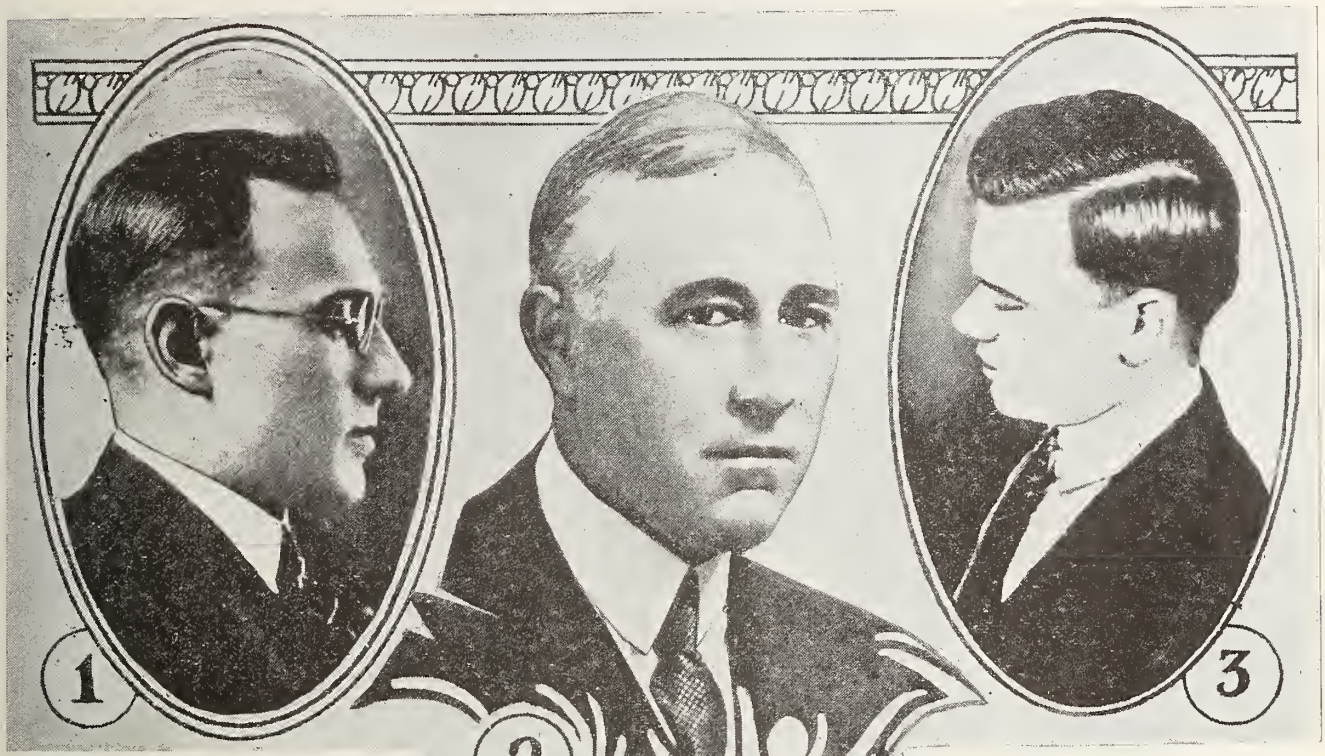
The actual selectivity required divides itself into two classes or conditions of service; one in which it is desired to discriminate between two relatively nearby stations of approximately equal signal strength but separated by some interval of wave length, the other where it is desired to discriminate against a nearby station and receive from a

(Continued on page 23.)

The Passing of an Old Friend

"W. J. Z. Signing off—Good Night"

By FLOYD JACQUET



The leading characters in WJZ's history: (1) C. W. Horn who made the first broadcast from WJZ at Newark; (2) H. E. Miller who developed WJZ's staff; (3) George Bliziotis chief operator; and (4) William H. Easton, director of WJZ, who delivered the farewell address.

YOU heard the familiar voice of the announcer say: "This is Station WJZ", as you have heard it many, many times before.

You may have detected a slight trembling, an undercurrent of emotion in the usually calm and even voice of AHN when he made this statement for the last time at the conclusion of the broadcast on Monday evening, May 14th.

"What" you said, "is WJZ, the first station I heard, going to close down? Aren't we going to hear our old friend's voice any more?"

The fact that the original WJZ, the one whose voice endeared itself to thousands of radio enthusiasts throughout the country, on that night spoke for the last time to its countless friends, North, South, East and West in many lands.

It was a simple event, this farewell of the old WJZ. There was no impressive ceremony, no occasion for speech making. WJZ passed out of the broadcasting firmament as simply as it entered it, quickly, and with dignity.

There were radio fans who swore by WJZ. It was the first station that many of us ever heard, our ABC in radio broadcasting.

WJZ led the field for one and a half years. This is a long period for a broadcasting station, and in that period many stations have been built and operated. When WJZ began its first famous broadcast on October 12, 1921, there were only three or four stations broadcasting throughout the land. Today, there are about 600, but in spite of this immense increase, WJZ has held its own, and in many ways, has led the way.

Day in and day out, faithfully, WJZ's kindly voice was at the beck and call of the knobs of your receiving instrument. It never failed you once. You turned it in and there it was. It entertained, charmed, or cheered you.

WJZ's sterling record was not a matter of luck. It required superhuman effort at times to uphold its past performance, and untiring efforts to provide the largest audience of any station with a peerless program.

Who were the men behind the scenes at WJZ, the personalities whose work went on, unknown to the audience, and who labored to make WJZ the better station at all times?

When it was decided in October 1921 to place WJZ in operation, there was no organization, no staff, no announcers, no artists. There was only a station, on top of the large plant of the Westinghouse Electric and Manufacturing Company, in Newark, N. J. As you go by on the Lackawanna Railroad, you can see the two high masts, supporting the antenna system. The first WJZ aerial was not as high, nor as pretentious. Neither was the station itself, located in a radio room specially built on the roof.

A radio staff was developed under the master hand of H. E. Miller, Superintendent of the Westinghouse Newark Works. Mr. Miller picked out from among the radio personnel of the Company, men who knew their jobs. Employees were tested out to find men with suitable radio voices to be trained as announcers. The entire radio personnel was Westinghouse, and went to work in the typical Westinghouse pioneer way.

In the first days of broadcasting, the operation of the station was rather difficult, the public was a bit skeptical, but interested. It was quick to applaud the efforts made, and to appreciate the superior programs.

But the work was tedious. Great credit is due to Mr. Miller and members of his staff who listened in night after night, checking up on the broadcasting, the modulation, and finally on the program.

The securing of good, pleasant and entertaining programs was no small task. This work as well as the general managing of the station developed upon Mr. William H. Easton. It was found that one of the most difficult things to do in the early days of commercial broadcasting was to interest newspapers in this new field. Untiring efforts on the part of Mr. Easton secured the recognition of radio broadcasting and awoke the duties of newspapers toward the hundreds of new fans.

WJZ enjoyed the distinction of being the first broadcasting station to have its complete program published by a Metropolitan newspaper. Over eleven hundred newspapers in the United States and foreign countries published the WJZ program. Much of this work was carried out by Mr. P. A. Sensenig.

In addition, WJZ has been the subject of many magazine articles and it has appeared on the screen. Dignitaries and men prominent in engineering circles have come from foreign lands to visit the station.

From a point of equipment, WJZ was rated as one of the most powerful broadcasting stations in operation in the country. Its original transmitter was of 500 watt power.

Last November, the power of the station was doubled, and WJZ could claim a transmitting radius of 2,000 miles. As a matter of fact, WJZ had the most consistent transmitting record of any broadcasting station. It was heard almost nightly in California and in England. It had followers in Australia, Cuba, South America and Europe. On one occasion, its signals were heard simultaneously in Honolulu and Bremenhaven, Germany, some 10,000 miles!

To keep a station such a time as this required the best of operators and the most competent care. Six licensed radio operators, all of them having had extensive practical experience either on land or sea or both, stood the practically continuous watch at the instruments. The Chief Operator, Mr. George Bliziotis was in direct charge of this work, and many times the proper operation of WJZ depended upon his quick, prompt and skillful handling of the situation.

The first man to ever broadcast station WJZ was Mr. C. W. Horn, when the station was officially opened up in October 12, 1921. Mr. Horn is now Superintendent of Communications for the Westinghouse Electric & Manufacturing Company. It is his duty to see that the other Westinghouse stations, KDKA, in Pittsburgh, KWY, in Chicago, and WBZ in Springfield are kept in the pink of conditions. That he has done his work well is shown by the fact that these stations are without rivals as far as range, consistent transmission and modulation are concerned.

Station WJZ was a pioneer in many ways. It originated many new variations in an attempt to put out a really interesting program.

Woman Is Boss

Station WDT has been reopened in its new home at 510 West 23rd Street, New York, in the studios of the Premier Grand Piano Corporation. The station is in charge of Miss Vaughn De Leath, the "original radio girl." The programs announced by the station are of outstanding merit.

For instance the method of identifying operators and announcers was introduced at WJZ, and the practice soon extended to every broadcasting station worthy of the name. The voices of AWN, (Mr. J. L. Watt); ACN, (Mr. T. Cowan); AJN, (Mr. M. J. Cross), all announcers, and OBN, (Chief Operator G. Bliziotis) and OHN, (Operator Hiller) are well known to thousands of radio fans. Some of them reflect truly the personality of the Station, and have made many friends for themselves over the radio.

The first time radio fans adjusted their watches was through the re-broadcasted NAA (Arlington) time signals from WJZ. This little innovation in the radio program was immediately popular, and spread out to many other stations.

And then, one afternoon radio fans who could not attend the World Series were startled to pick up the cheering of the crowds at the Polo Grounds and of receiving announcements of the plays, on their receiving sets. WJZ was broadcasting the baseball game reports. This was the first time that remote radio broadcasting was ever attempted in the Metropolitan district.

Subsequently, the first church service and then the first complete grand opera were sent out via WJZ's powerful installation.

But WJZ's entertainment was not for grown-ups alone. For the kiddies, bed time stories were told by children story tellers and authors of national repute. Sleepy ears heard many tales of Jack Rabbit, Bunny Briar and others from Thornton Burgess, David Cory, Florence Smith Vincent and Howard Garis.

The popularity of WJZ spread very quickly. The most prominent artists, public men and entertainers came to WJZ to broadcast. On the guest book of the WJZ studio and reception room may be found the names of Mary Sundelius, May Peterson, Cecil Arden, Frieda Hempel, Lydia Lipkowska, Vice President Coolidge, Premier Clemenceau, Lord Robert Cecil, Governors and Senators of many states, prominent lecturers and artists too numerous to mention.

WJZ's scope was international. Its waves radiated into parts unknown, and were heard throughout the civilized world. WJZ was the first station to be heard in England, and reception is being achieved daily in London. The programs of English stations are being modeled after WJZ's programs, because of their completeness and entertaining value.

But the old WJZ is shut down. It has found a more modern home in the Aeolian Hall Building, at 42d Street and Fifth Avenue in the heart of the city. Here a super-station has been erected by the Radio Corporation Engineers who were always interested in the development of WJZ. Mr. C. B. Popenoe went from the old WJZ to the new to manage its programs and its activities.

It may put on a new voice, be clothed in a new glory, but to many, old WJZ will be just "WJZ" an old faithful friend, whose presence we feel, and whose voice we love.

Monday night, right after the broadcast, the operator in charge made an entry in the station log book, as he has done every night for the last year and a half. This entry differed from all others, because it read:

"WJZ signed off for the last time. Station closed down—All's well."

Fake Inspectors

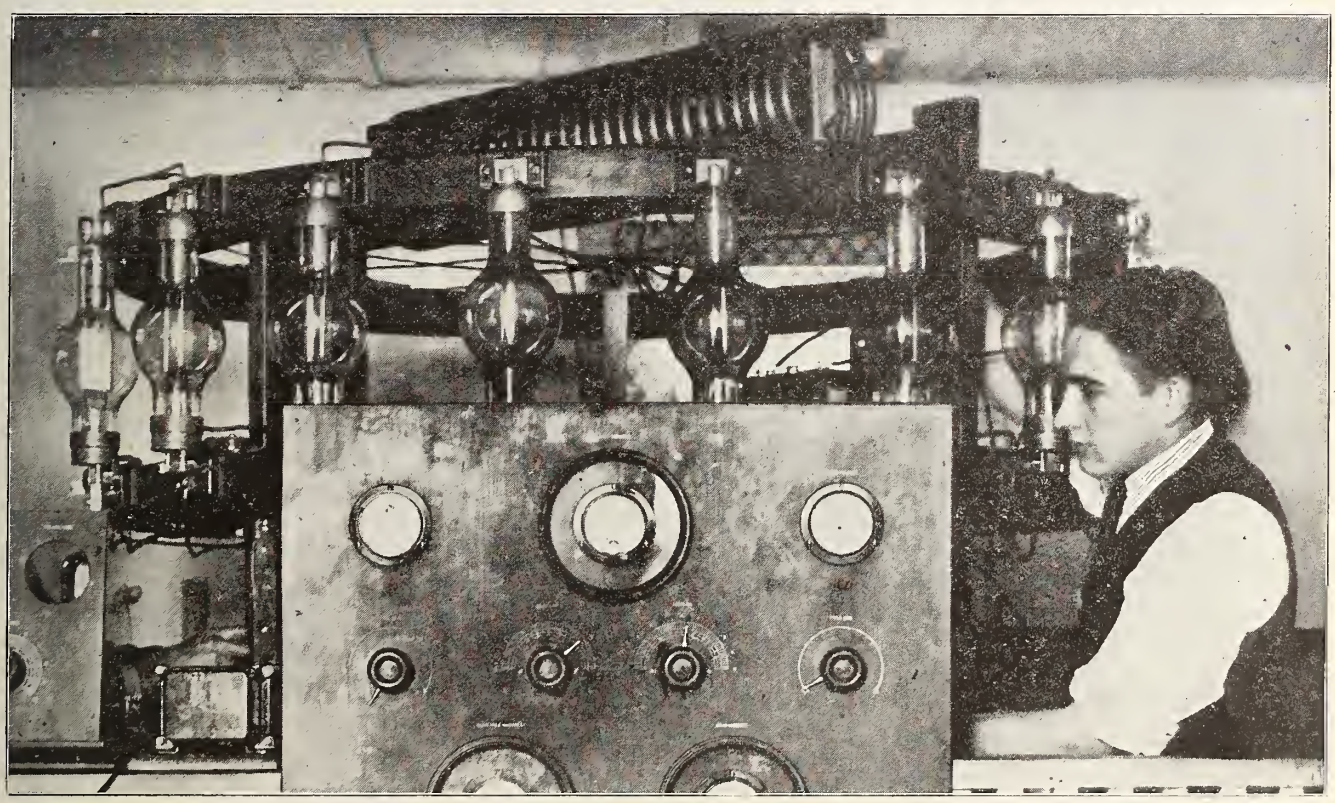
A "fake" radio inspector has been issuing "licenses" to amateur and broadcasting stations in Minnesota, the Department of Commerce has been advised. Using the return stub of an amateur application blank secured from the Department, an individual giving his name as Cecil Osborne is said to have supervised the installation of a radio station in Minnesota, and issued what he called a license.

This imposter claimed that he was a former radio operator of the Navy Department and a member of the Naval Reserve. The only record of a man of that name in the files of the Navy Department is that of a deserter who served for a time as an apprentice and seaman. He deserted in San Francisco in July, 1922, the official records state.

All radio inspectors of the Department, the officials in Washington point out, are supplied with means of identification, including official badges and identification cards bearing their photographs. Amateurs and broadcasters are advised to ask for identification cards and to pay no fees for licenses. Although the White Radio bill contemplated the payment of fees for licenses, it failed to pass; the present law provides for the licensing without charge.

W J A Z, a Station With a Difference

THERE is something about a great broadcasting station that suggests a combination of the pilot's cabin on a giant ocean liner and the foyer of a theater. There are instruments in the operating room that give an awesome impression of easy mastery over vast distances. A visit to the transmitting plant, always at some distance from the operator, gives one the same thrill that he experiences when looking at the equipment of an electric power station. With this difference, however, that the tubes and coils and wires here visible, all appearing to be alive with terrific, though pent up power, really do nothing more than to start thousands of electro-magnetic waves off on a journey that takes them at a speed so great that they could circumnavigate the earth about seven and one-half times a second.



Giant transmitter at Station WJAZ, Chicago, showing the arrangement of big tubes in a circle. The studio of this station is enclosed in plate glass. (U&U Foto).

The new Zenith-Edgewater Beach station, WJAZ, is such a station. WJAZ is not only a leading Chicago station, but it appears to be a bidder for national popularity.

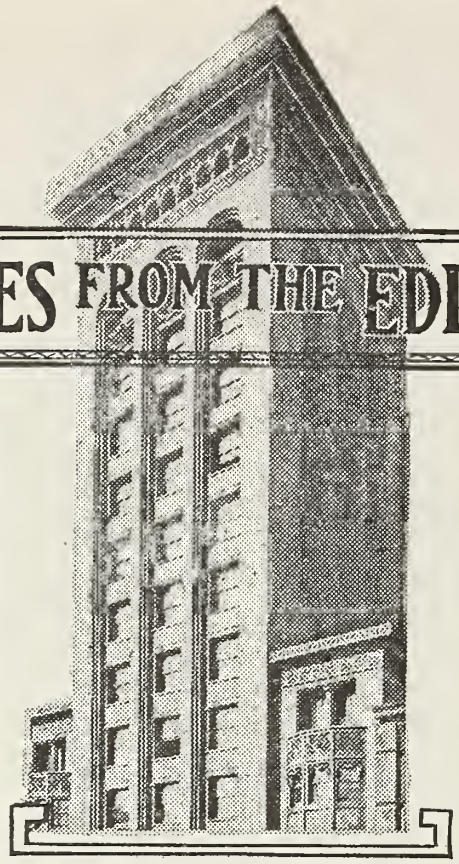
The station is powered by a ten kilowatt, 4,000 volt generator with a duplicate generator in reserve. On the opening night using only one-third of our power, it reached Oregon, California, Florida, Nova Scotia. It received 1,800 letters the Monday following the Saturday opening. It is now operating on a little more than half power and will probably not turn on full power until it starts talking with MacMillan on his North Pole trip. This station is to be used to communicate with MacMillan while he is on the Arctic expedition, sending to him not only the events of interest, but also communications from the families of himself and his crew.

The Crystal Studio is surrounded with three-ply, sound-proof, glass partitions. In the past, artists waiting to broadcast have been annoyed by two factors: First, the presence of microphones, and second, the absence of an audience. To overcome both of these difficulties, the microphones are carefully concealed and are not visible to the operators from any angle; as a matter of fact, they are concealed in the floor lamps in various parts of the Crystal Studio. The artists always have an audience to which they are singing, this audience being on the opposite side of the sound-proof, plate glass partition. Now, the audience can see the artists singing or playing, but cannot hear them. However, there is a small receiving set just outside the plate glass partition, so that the audience by radio hear the artists as they are performing.

The operator sits in a small, triangular, plate glass room and has full view of all the artists in the studio and the orchestra playing in the Marine diningroom. The entire performance of artists from the Crystal Studio is visible on the east from the Beach promenade, on the north from the hotel terrace, on the west from the Colonial diningroom and on the south from the Marine diningroom.

The generators and the antenna are located 300 yards north of the Crystal Studio, right on the lake shore, with no steel buildings on any side. The steel towers extend 175 feet into the air. The antenna is of the fan type with cage lead-in. An entirely new system of modulation is used in this station, which system will be disclosed as soon as patents, for which application has been made, are granted. Under the WJAZ system, there is no need of the artists being close to the microphones. As a matter of fact, in many instances, they are fully ten yards from the microphones, the volume being controlled entirely by the operator in the triangular glass operating room. The artists performing have every convenience of the artist on the stage, except one, and that is that they can only see the applause of their audience, but another microphone and a loud speaker are being added so that the applause of the audience will be transmitted through the sound-proof plate glass and will be audible in the Crystal Studio where the artist is performing.

Now as to the policy of the station. No talkers, whatsoever, are permitted, for the time being, at least. The program is entirely a musical entertainment, starting at 10:00 p. m., Chicago daylight savings time, and running until 2:00 a. m on Tuesdays, Wednesdays, Thursdays, Fridays and Saturdays, 5:00 to 8:00 p. m. Chicago daylight savings time on Sundays. The highest type of classical music with excellent artists from the Crystal Studio alternate with dance music every second number from the orchestra in the Marine diningroom.



THOUGHT WAVES FROM THE EDITORIAL TOWER

THE question, asked by millions in the last year, as to whether radio is a passing craze, has been answered. Gross sales of radio merchandise for the year ending May, 1923, were $100,000,000; double the total gross of the preceding year. You cannot laugh off that kind of showing.

Many other interesting figures about the growth of radio are contained in a survey published by the American Radio Journal. One item in the table shows that the number of manufacturers of radio sets and accessories decreased from 3,000 to 1,000. This is an apparent setback but actually it means that the industry has eliminated the fly-by-nighters. This pleases the fans. They want dependable equipment. The manufacturers themselves are benefited because the trade is being stabilized.

The America Radio Journal publishes the following figures:

	May, 1922	May, 1923
Dealers	$ 4,000	$ 6,000
Mfg. companies	3,000	1,000
Jobbers	1,000	3,000
Annual gross sales	$50,000,000	$100,000,000
Failures	500	5,000
Sets sold	100,000	300,000
Tubes sold	150,000	500,000
Values parts sold	$35,000,000	$70,000,000
Employed in trade	25,000	40,000
Mail order sales	$ 3,000,000	$ 4,000,000
Credit losses	250,000	3,000,000
Export gross value	100,000	1,000,000
Import gross value	250,000	3,000,000
Trade advertising	1,500,000	10,000,000
Broadcasters	250	600
Radio fans	500,000	2,000,000
Dealers' inventories	2,000,000	15,000,000
Newspaper depts	10	600
Radio publications	15	30

Predictions for the future are made by the same publication:

"The future seasons of radio have every promise of being even more phenomenal than that which has just passed," observes the editor of the publication. "With higher powered broadcasting, more efficient receiving sets, better circuits, better technical education, etc., the public is making radio bowl along faster than most of the trade appreciate.

"Sociologically, radio has already begun to change the habits and manner of living of millions. Its effects are no more to be stayed than the powers of a tornado let loose.

"We can predict safely that during the coming season, which really begins with May 1, that improved types of apparatus will mean a heavy resale market to old customers. What if $100,000,000 of merchandise was sold last year? Over $30,000,000 of it is replaceable. Tubes, batteries, panels, parts—almost any piece of radio has its deterioration loss.

"The traffic in 'seconds' is enormous and will increase. Yet every one is satisfied to buy more and more if he can improve distance, audibility, selectivity, etc. The field is fathomless. There is practically no 'absorption point' and as for the 'curve,' it will be straight up for at least five years to come—more so if broadcasting receives the proper support."

TECHNICAL experts are arguing whether or not, under the Arms agreement, the gun elevations of the American first line battleships may or may not be increased, when what we really need is radio and airplanes. In order to increase the range from around 21,000 yards to 24,000 yards, several degrees of elevation would be necessary, but with this increase neither the gun pointers nor the look-outs on the masthead could see where the shells fell. Airplanes with radio transmitters are the only means whereby battleships can fire with any degree of accuracy over 22,000 yards or about eleven nautical miles. Radio-equipped airplanes are also of great service under that range, especially in the case of a smoke screen, which would make a target invisible from the ship itself.

Due to the curvature of the earth, a rangefinder in a fighting top, about a hundred feet above the surface of the sea, can see the water line or horizon approximately no further than eleven miles distant, which is the resulting limit of accurate fire if he does his own spotting. That is, if the observers endeavor to tell the gun captains below how much short or over the target their shots fall or how far to the right or left, eleven miles is the maximum range.

For fighting top observations over this range much taller masts would be needed or airplanes which can spot by radio. To see the water line at 30,000 yards a fighting top would have to be 170 feet aloft—too high for practical purposes by many feet. Of course, a masthead lookout a hundred feet above the sea could see the mast and perhaps the superstructure of a ship over the horizon, but he could not see the fall of the shells in the water or their splash, and would only be able to tell if the mast or superstructure were hit, which would not aid the gun pointers in picking up the target.

It is for this reason that airplane spotters which can ascend several thousand feet, are used in the Navy and it is only by radio that they can report to the gunners the exact spots where the shells fall, thus enabling them to correct their aim.

What we need as much as gun elevating is more naval air spotters radio-equipped.

Loftiest Antenna

Towers of the new WMAQ station, on the roof of the Hotel LaSalle, will be twenty-two stories above the level of Madison Street. The antenna will be the loftiest in Chicago.

A memorial tablet recently was unveiled in Calvary Episcopal Church, Pittsburgh. The tablet was dedicated to the invisible congregation which for two years has been listening to church services broadcast from Calvary Episcopal through Westinghouse Station KDKA. The picture shows The Rev. Edwin J. van Etten, pastor, and H. P. Davis, vice president of the Westinghouse Company. The choir boys who have added so much to the radio services, are also shown.

Evangelism by Radio

That the broadcasting of religious services has increased church attendance; that radio has been a real help to the work of the church and has brought satisfaction and comfort to hundreds and thousands of people, is the opinion of the ministers of Schenectady who have been cooperating with M. P. Rice, director of broadcasting of the General Electric Company, in the transmission of church services.

From the inauguration of the radio church service by WGY, October 1, 1922, the studio management has cooperated very closely with the Ministerial Association, of Schenectady, N. Y. The Ministerial Association, which is made up of the pastors of all the evangelical churches, named a committee of which the Rev. Robert W. Anthony, pastor of the first Presbyterian Church, is the head, to assist the studio manager in the assignment of clergymen for the vesper services and in planning the order in which the services of different denominations should be broadcast.

In nearly every case the morning and evening services of a church are broadcast. The church is connected to the transmitting equipment of the broadcasting station by means of land wires. Two microphones are placed in the church, one for the preacher and another for choir and organ. But for the presence of the microphones, the church congregation would not be aware that the service, ordinarily limited to the four walls of the church, was going out into thousands of homes over a great territory.

Summarizing the first six months of broadcasting of religious services, Rev. Mr. Anthony made the following report:

"The first services were held on Sunday, October 1, when the morning service of the First Methodist Church and a vesper service from the studio were broadcast, and services have been broadcast regularly from that date. Recently, an evening service has been added to the program. On Thanksgiving day, the union service of the First Presbyterian and First Reformed Churches was sent out through WGY. New Year's eve came on Sunday evening, so a special Community Watch-Night service, commencing at 9 p. m. was arranged at the First Methodist Church and sent out through the station. A community three-hours service from 12 to 3 p. m. is to be broadcast Good Friday.

"As far as possible, each church equipped with an organ and good musical leadership has taken its turn. The ministers whose churches are not equipped with pipe organs have as a rule had charge of the vesper service. Occasionally, out-of-town churches have been invited to send out their services.

"At once, the participating ministers began to receive letters of appreciation, telephone calls, and words of gratitude from members of their congregation or acquaintances whom they met in the city. This made it possible to visualize the radio congregation. A large number of those listening in are aged and shut-in; some of them are partially deaf, others are blind, still others are helpless cripples. One patient sufferer for thirteen years, recently said that Sunday had been the longest day in the week until the broadcasting of religious services began, and now it is the best and brightest day in the week for her. Deaf people, who have not been able to hear the ordinary church service, can hear distinctly the service by radio. Mothers with little children who, on that account, are unable to go out to church, have been made happy by listening to the religious services. The gratitude and joy of people of this sort has been a revelation to the ministers who have participated. People who have not gone to church for years are listening with the keenest interest and with growing friendliness toward the church. Many of these send either through the mail or by some friend, a small offering to the church whose service they have heard. People in the country, unable to leave their farms, have thoroughly appreciated the broadcasting of religious services.

Homer Rodeheaver's famous chorus, and his own voice leading congregational singing, may become available to churches throughout the United States as the result of radio records now being made in Chicago.

Not only will the sacred services be within reach of the churches, but private homes in the city or the remotest parts of the country may tune in for the very highest type of religious service, as it is offered in the wealthiest congregations in the United States.

Arrangements have already been completed with the National Broadcaster's League, which has stations in twenty different states, to obtain the syndicated service as it is now being prepared in a Chicago studio.

The broadcasters will relay the regulation service, from prelude to postelude, on a precise schedule, each number beginning and ending at a precise time so that churches may employ their own sermon or their own offertory at option and tune in for the special music or sermon.

The regulation services, as they have been prepared by Mr. Rodeheaver, consist of ten or twelve records which are packed and distributed to the broadcasting stations affiliated with the league. Two specially constructed reproducing machines will carry the service through, one machine overlapping the other by a newly patented synchronizing device, so that there is no break at the end of one record and the beginning of another.

A number of noted divines have been engaged to deliver inspirational sermons and express modern religious thought. It is intended to have the service ready to supply churches in time for the midsummer period.

Little Things That Help

Easily Constructed Grid Leak

There are times when you are experimenting with various circuits and you find yourself minus a grid leak. An efficient, variable and permanent grid leak may be constructed by cutting a piece of bristol board to the size of a grid condenser, punching two holes to allow it to be bolted on to the condenser, as in the illustration. Two washers make contact with the markings of a very soft lead pencil. The marking is allowed to protrude slightly around the edge of the washer. After the parts are assembled, it is connected to the set in the usual manner. When the set is

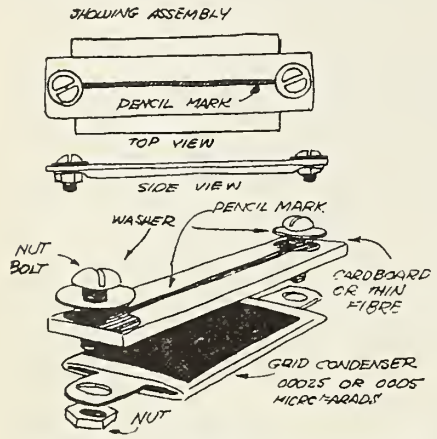


Figure 2. A grid leak of unusual efficiency and flexibility can be inexpensively constructed as shown.

turned on, the grid leak is adjusted by taking a pencil and drawing a line from the markings along the washer across the cardboard. The heavier the line, the less resistance, and the lighter line the higher resistance.

The action of the grid leak is to keep the grid of the tube from accumulating an excessively strong negative charge, which would make the tube inoperative, or as some prefer to say "paralyze" it. By listening in on the telephone receivers, it can be ascertained whether the leak is functioning properly. If the signal is "mushy." the reason is probably too much pencil marking, and if it thumps and knocks there is probably too little marking.

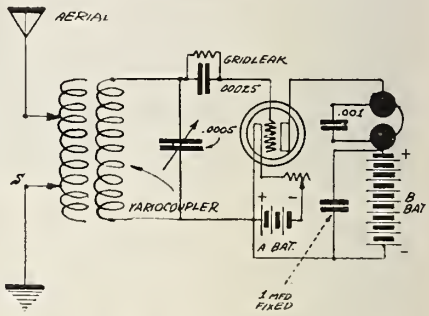
How to Eliminate Interference

Various methods have been tried to eliminate various kinds of interference. A new method has been originated, radically different from the conventional wave trap, which applies specifically to various forms of interference and tuning difficulties. This is the filter. For those who are troubled with interference from stations using continuous waves, a filter of the type in Figure 1, A is recommended. This is constructed by having a winding of about forty turns of number 28, D C C wire, which will make a coil of about one inch in length. Over this coil there is wound about three or four layers of heavy writing paper, after which the coil is connected to a 23-plate condenser of good make. Over the larger coil a smaller coil, consisting of about from three to five turns, should be wound, which is connected to the set as indicated.

If you are having trouble from Spark stations, the filter in B, Figure 1, will usually assist in tuning him out. If your antenna is a small one, the addition of a 25-turn coil in the antenna lead, to bring its fundamental up higher, will probably help in making the filters a success.

By-Pass Condenser for "B" Batteries

IN some circuits in which a high pressure is used on the plate, much better results have been obtained by shunting the "B" battery with a fixed condenser having a capacity of from 1-4 to 1 micro-farads. This is especially useful in cases where the pressure ranges from 80 to 150 volts. Using a fixed condenser of .001 M. F. across the phones is common practice and the reason for this is that the phones offer considerable impedance to the radio frequency current flowing in this circuit, and the condenser will cause them to pass around the phones. After getting past the phones it must also pass through the "B" batteries and if this battery consists of many small cells which are necessary to bring the voltage up to 100 or 150 volts, then the internal resistance of these cells becomes very high; not so high for low frequencies, but high enough at radio frequency to need consideration. Therefore, shunting the battery with this large condenser, as shown in the



drawing will help considerably. As the condenser used for this purpose has too much capacity to be used across the phones, it will not do to employ the one condenser for both, but two separate condensers of the proper capacities should be used as shown.

Correction

The circuit shown on page 10, in Figure 2 of the June issue should indicate a 23-plate vernier condenser, connected across the secondary circuit, from the left-hand side of the grid leak to the positive filament and bottom side of the coupler. The couplers should not be placed in inductive relation, but should be spaced not less than six inches. Number 22, DCC wire may be used throughout in winding the coils on the couplers.

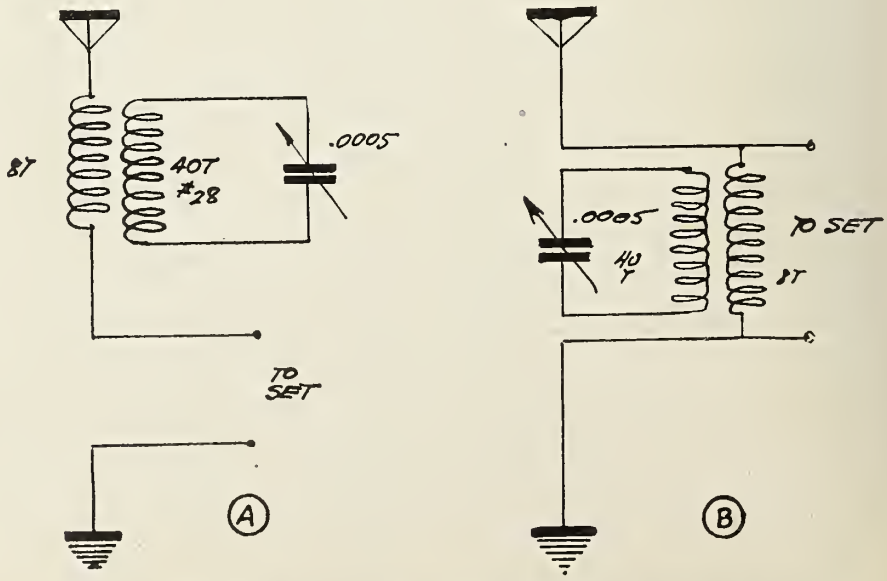
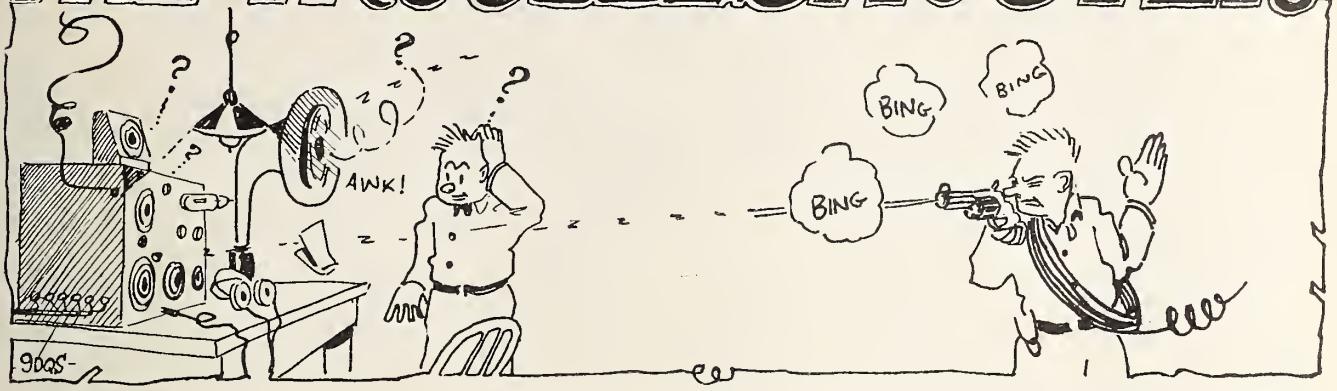


Figure 1. Two types of filter systems, which have been used with great success in eliminating interference. One or more of the type illustrated under A can be used for each interfering wave.

THE TROUBLESHOOTER



L. L. R. Monroe, Mich.

Question: I am just beginning the radio game, and I wish you would send me a diagram of a one tube set.

Answer: In Figure 7, I am printing a regenerative circuit, which will give very good results. L 1 is a coil of about

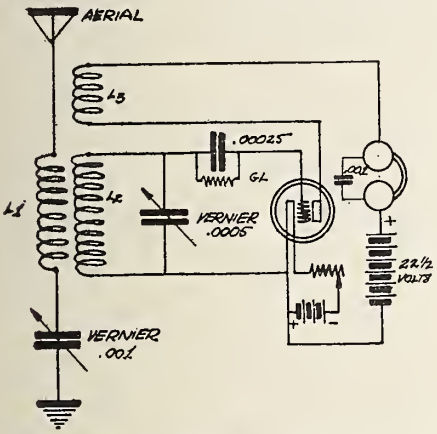


Figure 7. Many of our readers are asking for an easily constructed inexpensive one tube set. Here's one using two condensers and homemade inductances.

forty-five turns of number 20, D C C; L 2 is another coil of about fifty turns of number 22, D C C, and L 3 is a tickler coil having seventy-five turns of number 22, D C C. All coils should be wound on a cardboard tube three inches in diameter. The condenser connected across L 2 is a 23-plate vernier, while the condenser in the ground circuit is a 43-plate vernier. All the coils should be placed in inductive relation to one another.

I. C. M., Ventura, Ia.

Question: I am an interested subscriber to the Radio Age, and would appreciate it if you would give me a little advice on how to eliminate static, which is very violent in this section of the country now. I use an indoor antenna 150 feet long, with a single circuit regenerative receiving set. If you will send me a circuit showing how to eliminate this nuisance, I will feel eternally grateful to you.

Answer: As much as I would like to, I am sorry to say that I can not give you a circuit which will cut out static. Static is a phenomenon which has been under observation and investigation for years in hope of finding some method whereby it may be eliminated in radio reception. The man who solves the problem is deserving of much praise and monetary returns. However, I am printing in Figure 2 a circuit which you will find is comparatively immune to atmospheric interference if properly constructed and operated. A complete description of this circuit appeared in the April number of Radio Age. You might try shortening the antenna you now are using, which affords less chance for accumulating static. Also while operating your set, keep the filament turned down as low as possible without interfering with the reception of signals. Can also advise that you listen in during the twilight periods, early morning and evening, before sunrise and after sunset. During this period, the static abates. Be sure that your antenna is properly grounded at all times, if the static is bad in your portion of the country.

G. W. H., Long Island City, N. Y.

Question: Please tell me what use to make of the three switch points on the grid circuit of my Reinartz set. As long as I have been using it, I have found use for only the last one. The others only weaken signals or exclude them entirely. I replaced my 11 plate condenser with a 23-plate which enabled me to tune in WEAF at 492 meters, and also permitted me to separate the following four stations: WEAF, WJZ, WJY, WOR, and others. I have eight switch points on my antenna circuit and find use for about four of them. The others do me no good. What are they there for? I use an L 1500 honeycomb coil in the plate circuit between the detector and first state of audio frequency. Is this a new stunt? It increases the tone and volume of the set. Why is this?

Answer: The reason you find that some of the switch taps on your set are not all active is that the designer wished to provide for different types of antennas and systems, and therefore made the set flexible so as to function with practically any system. Probably if you had a different antenna system you would have to use entirely different switch taps in tuning. The honeycomb coil in the plate circuit is not a new feature, but is often a good one. Would advise that you use a smaller coil in this circuit, as I am sure you will get better results. The introduction of more inductance in the plate circuit, in this case, effects greater ease in making the set oscillate

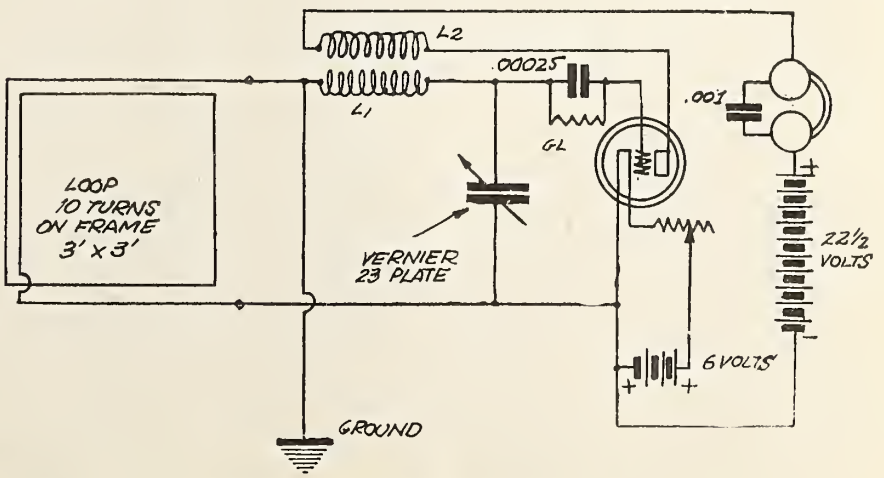


Figure 2. The one tube loop antenna set, described in the April issue, can be used to advantage for excluding static and interference, and makes an ideal portable set for summer use.

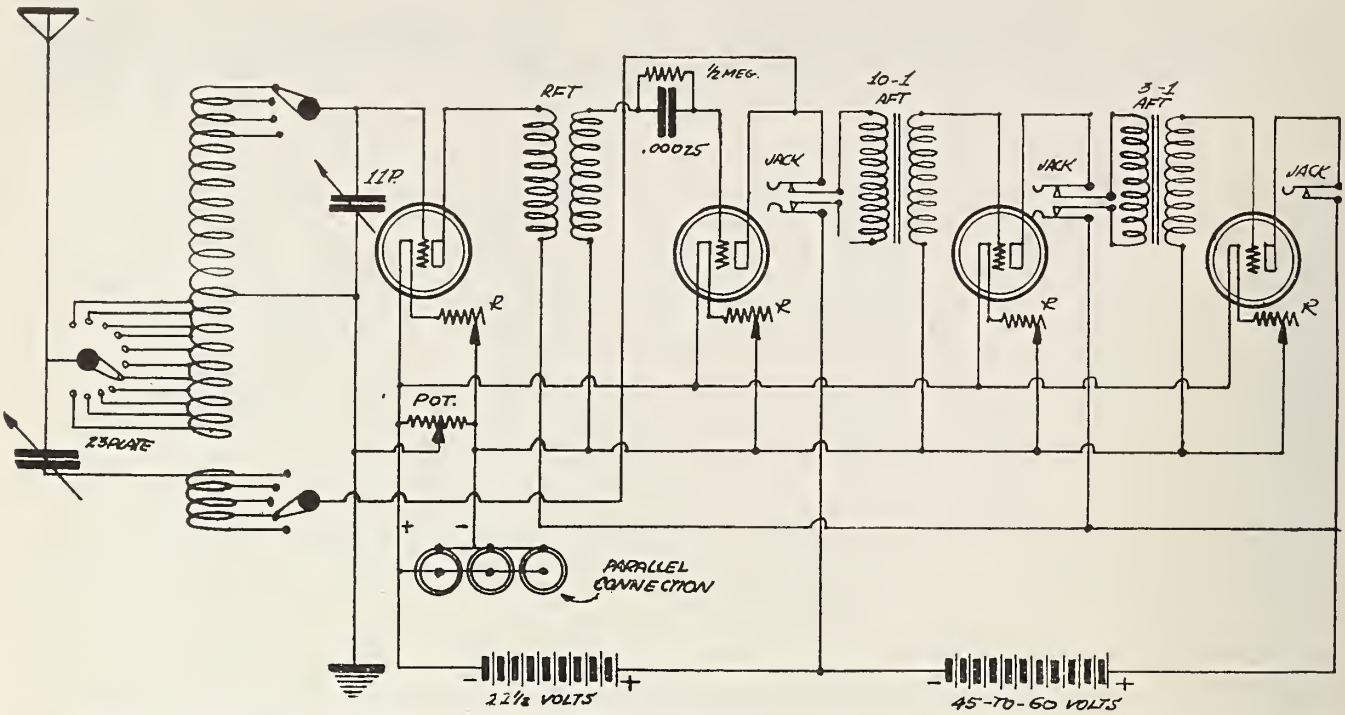


Figure 1. The Reinartz circuit with one stage radio frequency, detector and two stages audio frequency amplification, using WD-11 tubes.

and gives greater feedback properties than if no coil were inserted.

A. W. M., Indianapolis, Ind.

Question: In your May issue of Radio Age, you have the Erla reflex circuit, and after having considered have decided to construct a set using this circuit. Kindly tell me if the variocoupler has one or two sets of switch points; the drawing shows only one set, but the text provides for two sets, when the circuit does not show another set. You speak of the U V 201A or C 301A tube as being the best. Will the W D 11, W D 12 or U V 199 work in this circuit?

Answer: Provision was made for two kinds of variocouplers in the text. If you should decide to use a variocoupler having two sets of taps, connect the one set of taps to the antenna through the switch, and the second set to the ground through the other switch. This will give greater selectivity, and afford greater ease in tuning. Any of the tubes you mention will give satisfactory results in the circuit, but the 301 tube is to be recommended.

S. E. L., Memphis, Tenn.

Question: I am a reader of the Radio Age, and hav e your book on "Reinartz Radio," from which I built my set with two stages of amplification, audio frequency, using W D 11 tubes. I have had some difficulty in making the set "talk" and am not quite satisfied with the results, although the set has convinced me that it will do all that you claim for it. It picks up stations from the Rockies to the Atlantic, but I cannot tune up the detector tube high enough for clear reception without too much noise. On advice of so-called local "experts," I substituted a 23-plate condenser for the 43-plate, which they claimed was necessary with W D 11 tubes. I would ake to have you answer a few questions lind oblige a number of interested BCL's as well as myself. If you have a diagram showing one stage of RF amplification, detector and two stages AF amplification, will you please mail it to me? The questions: Does variable condenser suggested in grid circuit replace grid leak also, or is it necessary to have a grid leak and variable condenser also? What size grid leak do you suggest in the grid circuit? I am using double cotton enamel in the coil. Would single silk enamel be any better? What about the Thorardson transformers with respect to ratio; they are simply marked high ratio "white top" and low ratio "red top." Will they be OK for the set? I am considering adding one stage of radio frequency; your book shows an 11 plate condenser replacing the 23 plate. Is this correct? Is the Reinartz set successful with one stage of RF using W D 11 tubes?

Answer: The noises which you mention are probably caused by one of the following reasons, viz.: an improperly adjusted grid leak, too high a plate potential on the detector tube, or faulty connections in the set some place. Would advise that you sandpaper the rheostats so that the resistance wire is bright and clean, and to make sure that each connection is not noisy, take a hot soldering iron and touch up all the connections leaving them a bright, smooth bit of solder. Try a smaller grid condenser, adjust the grid leak carefully, and ascertain whether the transformers are working properly. I am printing the circuit you ask for in Figure 1. Notice how the battery for the filaments is connected up. This is necessary when more than one W D 11 is used in a circuit. With reference to the other questions: A grid leak is always advisable in the grid circuit to keep an excessively high negative charge from accumulating on the grid of the tube. The leakage of a variable condenser might provide this but it is better to have one in the circuit. Use either a .00025 or .0017 condenser in the grid circuit. Not necessarily variable. A grid leak, adjustable in variations from 1-2 to 1 1-2 megohms is satisfactory. Silk enamel would be better; it affords higher insulation. The transformers you mention are OK for the circuit, the ratios being correct. Use the white top in the first stage AF and the red top in the second. The 11 plate condenser is correct in this circuit. W D 11 tubes will function satisfactorily in the circuit in Figure 1, but will not afford as much volume as a six volt tube would give.

C. W. H., Bristol, Ind.

Question: Being a subscriber to your magazine, I have built a Reinartz receiver, using two stages of amplification with two steps of amplification, using a Pfansteihl coil. I built the set according to directions in the September issue of the Radio Age with the exception that I am using 23 and 11-plate condensers instead of 23 and 43. Which do you consider the best? I am having excellent results with this set, much better than my friends, who have various other kinds of sets.

I would like to have you explain to me what changes I should make in my set so as to be able to get the stations using the new wave lengths. Would you suggest that I build a different type of receiver? If so, what kind? Do you recommend reflex circuits?

Answer: I am glad to hear that you are getting results with the circuit you mention. You will not have to rearrange or rebuild your set to meet the present wave length system, as the highest waves are in the vicinity of 500 meters, and your set will easily tune to this wave. The Reinartz circuit works about equally well with either 23 and 43 or 23 and 11-plate condensers. A reflex set, if properly constructed, will often work as well,

or better, than some of the coventional circuits now in use. Great care must be exercised in constructing them.

Mrs. C. E. B., Stockton, Ill.

Question: I have a Westinghouse Aeriola SR receiver, type RF. Can you please recommend any special hookup for one step of audio frequency amplification to be used with the headset, and two step to be used with a loud speaker?

Answer: I am printing, in Figure 3, a diagram of a two step amplifier, making provision for the use of either headphones or loud speaker. The phone posts on the detector of the set you now have should be connected to the designated posts on the amplifier. The rest of the connections are plainly shown in the diagram.

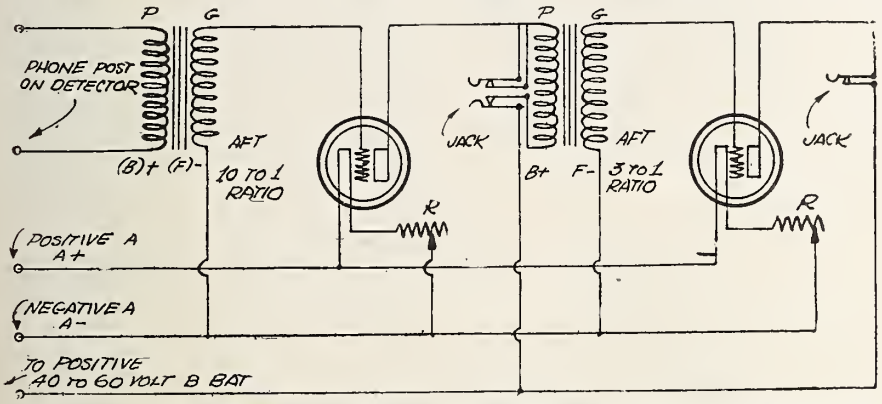


Figure 3. A two stage audio frequency amplifier, constructed with binding posts as in the circuit, can easily be connected to any set, as shown.

L. P. G., Chicago, Ill.

Question: I am having trouble with a sputtering and cracking noise in my set—consisting of a two stage audio frequency, with a regenerative detector using honeycomb coils. I have used my B batteries on two other sets, and have no trouble from them. I have tested the transformers, and they seem to be OK. They are spaced more than three inches apart in the set. All connections are very short. I use a C 300 for detector and the U V 201 A for amplifiers. I wonder if you could help me locate the misery causer. I don't think it's static, because I use an indoor antenna which, by the way, is 160 feet in length. I have watched your magazine very closely every month in hope of finding something which would apply to my case, but have found nothing. What would you suggest?

Answer: I am of the opinion that the limitations of your set are due to either poor connections, faulty transformers or the improper use of the U V 201A tubes in the amplifier circuit. Would advise that you take a hot soldering iron and go over each of the connections, making sure that it is firmly and well soldered. Sandpaper the resistance wires and slider on the rheostats. If you are using jacks, make sure that no flux or soldering paste remains on the lugs, as this is often the cause for set noises. Reverse the tickler coil in the set to find out if it is wound in the proper direction. Try it both ways. Make sure that the prongs on the tube sockets are clean and make good contact. Faulty transformers might be the cause of your trouble, this being determined by the use of other transformers. From your letter I cannot tell whether you are using the proper rheostats on the U V 201 A tubes, but will say that if you are using the ordinary rheostat, would advise that you turn them up only to make contact with the resistance wire on the rheostat. The reason that this is necessary is that too high a filament potential will render the tube inoperative, and the only way to make the tube come back to normal is to burn the filament at normal brilliancy for a period of time with the B battery off. This will bring back the filament emission of electrons. Make sure that the A battery is correctly connected, as the reversal of polarity makes the amplifier inoperative, giving only a lot of noises. A negative charge must be sustained on the grid of the amplifier tube in order to make them function properly. Of course your trouble could be static, but you will have to determine that for yourself. If you are getting noises on one set and not on the other, with simultaneous operation, the trouble is not static. If you hear them with both sets, you may be sure that you are having trouble with atmospherics, and the only way to avoid them is to put in a circuit as in Figure 2.

H. J. J. Crestwood, Ky.

Question: In the Erla reflex circuit in the May number, your drawing shows the transformer markings as being minus and plus, but the transformer is not marked this way. Marking on the transformer are A and B. How do they connect them with these markings?

Answer: The connections, as you indicate, are the same as on our diagram with the exception that our diagram was a little more specific. The marking A on the transformer indicates the filament negative or A—while the marking B on the transformer indicates the plate battery positive, or B+. The AF transformer you mention in your letter will be satisfactory in the circuit.

B. R. C. Iroquois, Iowa.

Question: I have a three-stage audio frequency set which has only one variometer and no coupler, and I would like to know if the circuit can be rearranged to bring in long distance stations by the addition of a variocoupler. Please give me a circuit showing how this is done.

Answer: I am printing, in Figure 6, a circuit which will bring in long distance stations using the apparatus you now have, with an addition of a variocoupler, one condenser and a small honeycomb coil. The audio frequency is added in the usual manner, the input of the first stage of audio frequency connected to the phone posts on the detector. In this circuit, L 1 and L 2 are the primary and secondary of a variocoupler respectively, and L 3 is a 25-turn honeycomb coil. The condenser across the secondary of the variocoupler is a 23-plate vernier. The variometer in the plate circuit makes the set regenerative.

F. H. Chicago, Ill.

Question: Can you give me a detailed drawing of a tuning system with which I can tune out KYW, WDAP, and WMAQ while they are sending. I have tried every circuit nearly, Flewelling, Reinartz, Reflex and Regenerative; but no use, I don't think it can be done. Have been trying RF and AF, but that don't do it. I live only two miles from KYW and it surely blankets everything else. On silent nights I can get Kansas City, St. Louis, Memphis, and Minneapolis on one tube, but other nights I can

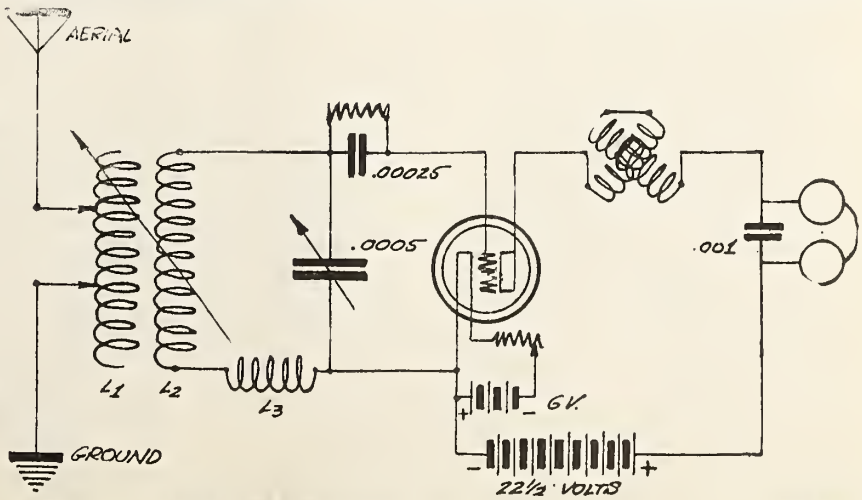


Figure 6. An efficient regenerative circuit using a condenser across the secondary of the variocoupler with a 25 turn honeycomb coil, which tunes very closely.

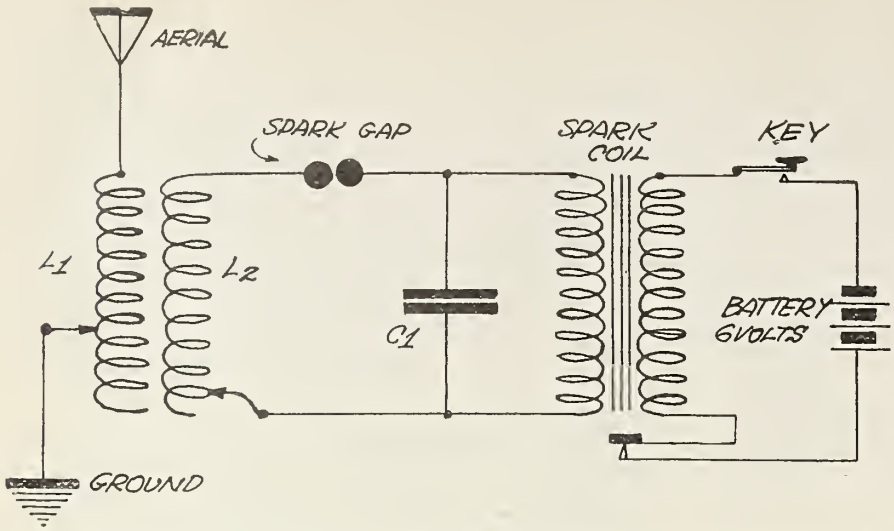


Figure 5. A spark coil if connected up in this manner, makes an efficient short distance transmitter. The ordinary automobile spark coil, with vibrator, can be used.

not tune out the local stations to get any DX

Answer: Your location is a very bad one from an interference viewpoint, and about the only recourse you have is to put in a loop receiver, something on the order of this month's circuit, with which I am sure you will be able to exclude this excessive interference. You might try using a wave trap or a filter in the circuits you now are using, and also to decrease the length of your antenna, so that it will tune more sharply.

F. N. Sta. D. Milwaukee, Wis.

Question: I understand that an automobile spark coil can be used for a transmitter. How is it hooked up?

Answer: I am showing, in Figure 5, the proper connections for a spark transmitter, which will give a very sharp wave, with a minimum of interference. L 1 is a coil of about twenty turns of number 12 solid copper wire wound in a pancake form. L 2 is another pancake coil of number 6 or number 8 solid copper wire of about six turns. C 1 is a tinfoil and glass condenser, having a total of about thirty sheets of tinfoil five by six inches, fifteen sheets on each side. To transmit you must have a license, which will be furnished free of charge by the radio inspector of your district. You must be licensed, as a heavy penalty is provided for unlicensed stations.

S. S. Quincy, Ill.

Question: I wish to mention that I have received my first issue of Radio Age, and find it chock full of radio knowledge. It certainly cannot be beat. I would like to have you go over the enclosed diagram showing how I have connected up my set, to ascertain whether it is correct. I have connected my set up this way and I do not get any results, and would like to know if it is the set or the circuit. The RF transformer is of the air core type. I cannot possibly locate the trouble after having gone over the wiring with the utmost care and finding no errors. Can you set me on the right track?

Answer: You bet we can S. S., because your diagram is not correct. Connect up your apparatus as in Figure 4, and you will certainly get results. The three-plate condenser across the primary of the RF transformer will afford greater ease in tuning. Potentiometer should be from 200 to 400 ohms. L1 and L2 are the primary and secondary of the variecoupler. The condenser across the secondary of the variocoupler is a 23-plate vernier.

C. W. J. Glens Falls, N. Y.

Question: I recently hooked up a Reinartz set, consisting of a detector and two stages of audio frequency, according to your instructions, and had the best of results. I am trying to make a change to the hookup to a RF amplifier, detector and two stages AF, using Rasla transformers, 13 and 5 plate condensers U V 201, 200 and 201 tubes, respectively, but all I can get with set hooked up as it is, is a beat note in the phones. This note can be varied by turning the condensers. Local experts say that this beat is caused by an open circuit, but I cannot believe it, as I have tested out the circuit for breaks. I have tried several sizes of condensers in the grid, have a variable grid leak, tried a small choke coil in the plate circuit of the detector and also tried to put in a small choke coil between the radio tube plate and the primary side of the RF transformer. Can you enlighten me as to the cause of the beat note, and its cure? All I have been able to get is Schenectady, which is about fifty-two miles away, and I get them so faintly that I just about could hear them. In what way would larger condensers affect the circuit? Radio is supposed to reach farther, but can I get volume as I had before I tried to change?

Answer: The beat note you speak of is probably caused by the RF amplifier in your set acting as a detector, rectifying the signal instead of amplifying it. The reason you caught Schenectady is that probably your RF tube and detector tube were tuned to the same frequency, thereby allowing the signal to slip through. Larger condensers in the circuit will increase your wave length. If you will connect up your set as in Figure 1, you will get the advantage of both added volume and increased range. The circuit shows the connections for W D 11 tubes, but you will have only to make it apply to your source of filament potential. No changes in the circuit will be necessary.

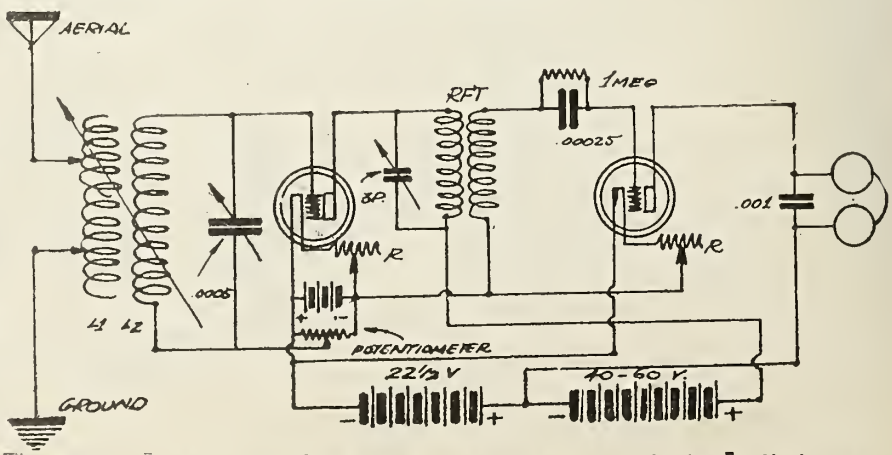


Figure 4. This circuit shows how to use a plain variocoupler in a radio frequency detector hookup.

Kinks

One of our readers, who lives in an outlying district, found that he had no spaghetti tubing with which to insulate the set he was constructing, and in order that he might quickly have a substitute, purchased common soda straws from a local drug store, shellacked them, and used them in the regular way in place of the regular tubing.

Another one of our readers, Clarence Peterson, says that a vernier on the condensers and variometers of your sets are not needed, if you have a lead pencil having a soft rubber eraser on it. He says; "Place the rubber firmly against the panel, with the side of the eraser against the dial. A slight turn on the pencil will give a very small movement of the dial of the condenser. It is about as close as any vernier will give. It also does away with a great deal of body capacity, because your hands are not near the dials of the set when the pencil is used."

Pickup Records From Our Readers

Spartanburg, S. C.

Radio Age:

I have just sent in my subscription for the Radio Age, and wish to say that it has more diagrams and helps to the radio BCL than any other book now on the market. I have been buying it heretofore on the stands, but do not want to take the chance of missing a copy, therefore my subscription.

I have a set with which I am getting good results, the Armstrong regenerative circuit, which I have modified slightly, and which I find works better. With this hookup I have received the following stations: KDKA, KLX, KYW, WAAB, WAAC, WAAD, WAAL, WBAP, WDAJ, WEAF, WGAQ, WGAS, WGF, WGM, WGY, WHAS, WHK, WJAX, WJZ, WLK, WLW, WMAQ, WOC, WOH, WOR, WOS, WSB, WWJ and Canadian CKAC.

WILLIAM SIBLEY LAW,
Saxon Mill, Spartanburg, S. C

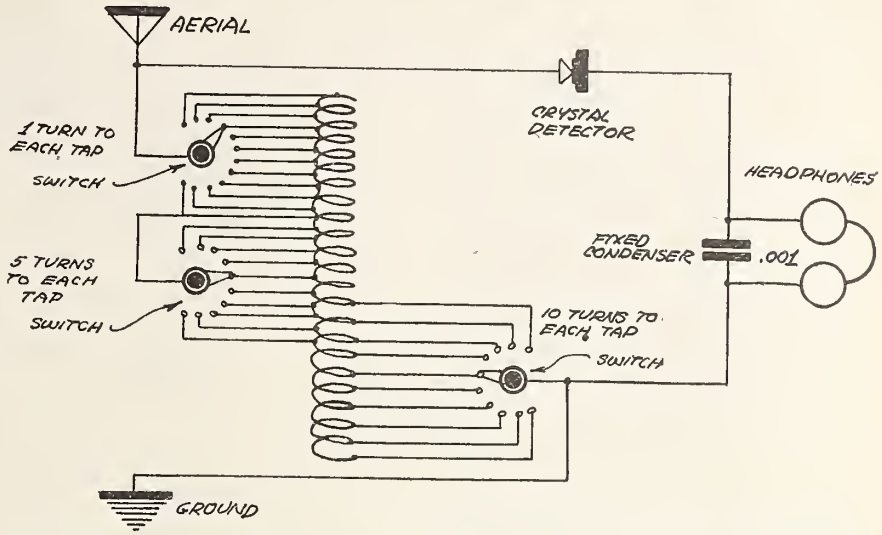


Figure 2. Mr. Smith's adaptation of the Bureau of Standards crystal set, with which he is getting unusual results.

Danvers, Ill.

Radio Age:

A variety of devices for amplifying the sounds received through the receiving sets are now on the market for the choice of the owner of a radio receiving set, but if his means are limited, the ideas illustrated herewith may be applied at a total expenditure of less than a dollar.

The only material required is one or more small force cups, such as can be bought from any plumber or hardware store. Usually these cups are mounted on a wooden handle, as in A, Figure 1. The handle is removed as it is not used. Between the handle socket and the hemispherical cup there will be found a dividing wall of rubber, which must be cut out, as in B. The head set is fitted inside of these cups which are then slipped over a T arm as in C, one of the arms being connected to the phonograph horn or other horn to be used. If only one receiver is used, no T arm is necessary, the cup being fastened right on to the tone arm of the phonograph.

GILBERT R. HEDRICK,
Danvers, Ill.

Philadelphia, Pa.

Radio Age:

I am enclosing a pencil drawing of a modification of the Government Bureau of Standards on the simple tap and coil crystal hookup. This consists of a coil tube tapped as follows:

10 tens.
10 fives.
12 single taps of unequal lengths.

Three switch buttons or levers are required instead of two. A complete circuit is obtained by breaking the last tap on the five and connecting one end to the last five tap and the other end to the center of the five switch lever, as in Figure 2.

While I fail to see any additional increase in tone, I do find that there is a greater variety in combination tuning and also if an additional wrapping of about thirty turns before the first taps are taken on the ten side that all wave lengths contemplated will be taken care of with ease.

I would like to have your readers follow this hookup and report their tests to your paper. Most of the experimenting I notice has been done with tube sets, and while I have been connected up with tube sets for about two years I still stick to my original crystal set as I enjoy the freedom from tube noises and other machine noises so frequent on the average tube set. My own special crystal set is very loud; in fact, with a

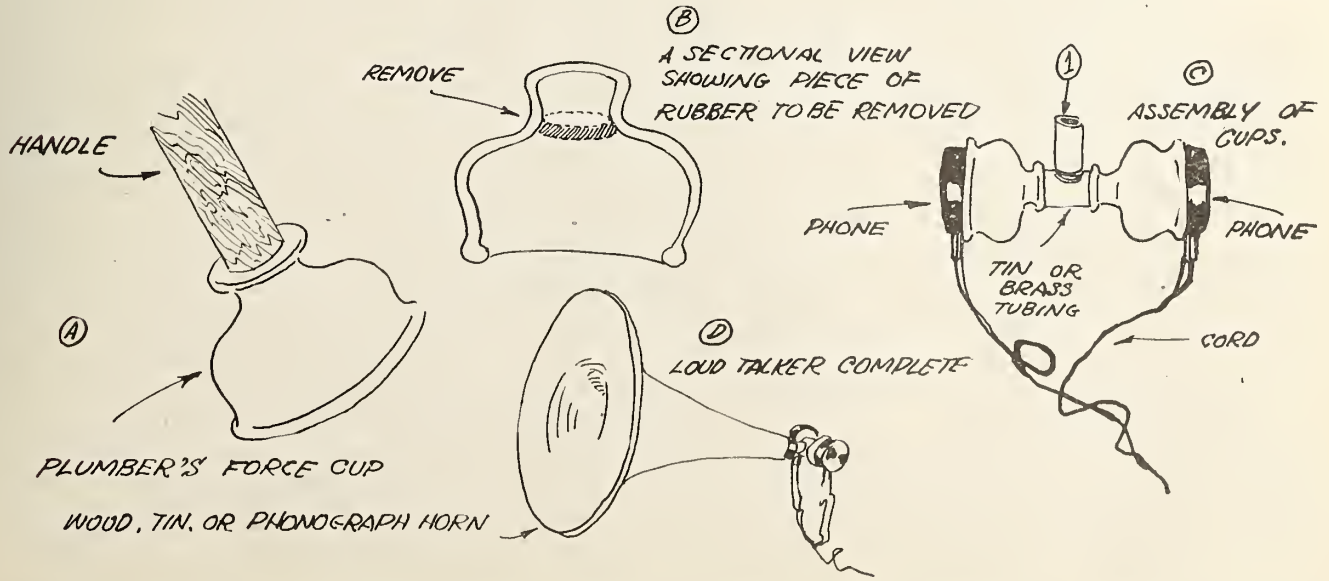


Figure 1. An inexpensive, easily constructed and novel loud talker can be constructed using parts obtainable in the average plumbing or hardware store.

pair of ordinary phones I can place the phones on the wall, face out, and understand everything coming over the air, throughout the room. Other crystal set owners all declare that they cannot get theirs nearly so loud.

W. P. SMITH,
Philadelphia, Pa.

That Hopwood Circuit

MANY of the eastern radio fans are getting quite a kick out of a new circuit which was not supposed to be. A fan by the name of Hopwood, who lives in Philadelphia, while trying to unravel the mysteries of a blue print, got so badly tangled up that he got the secondary of his coupler hooked up to the plate instead of the grid, accidentally producing a feed-back, which according to reports, puts the other feed-back circuits way back into the crystal detector class.

Unlike most fans who have glory suddenly thrust upon them, Hopwood doesn't say, "I told you so," but he wants to know what it is all about and has called into consultation radio engineers from far and wide to tell him why it works. Anyway, we must give him credit for giving us one of the most efficient dry cell tube circuits ever slipped over, and after all what do we care how it was done, if it does what they say it will do? He has rendered a great service to the army of radio bugs, so let us all give three cheers for Hopwood!

The accompanying diagram shows how he did it, and the simplicity of the circuit will immediately appeal to those enthusiasts who are always looking for something new. It will be noticed that the variometer is connected in series with the primary of the coupler. There is, however, no inductive relation between the two. The grid is connected to the aerial and the plate to the secondary of the coupler.

In Boston!

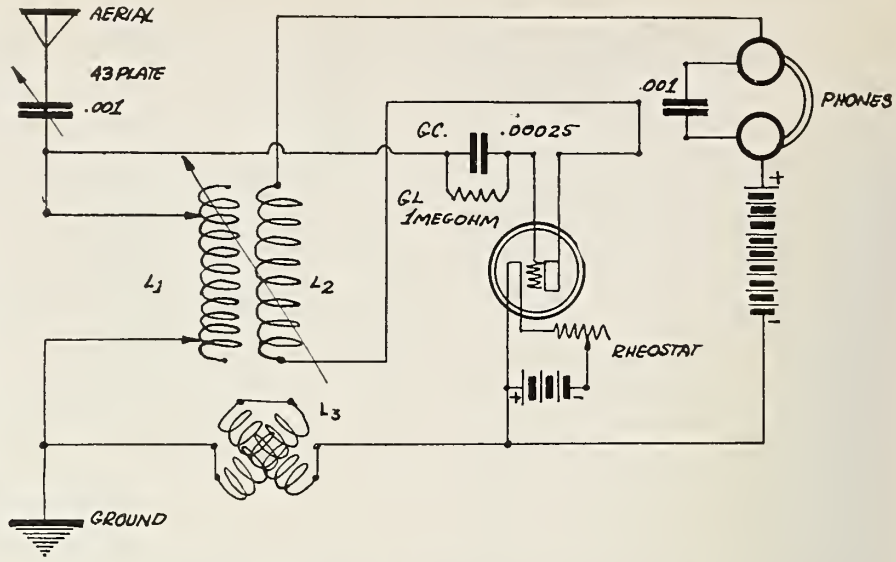
The Boston Post publishes a poem which is entitled "Modern Mother." The verse shows how mother nowadays passes up her knitting for a three-tube receiving set. The first stanza starts like this:

We never could educate mother
To give up her old-fashioned way;
A little black bonnet with lavender on it,
And a shawl, she was dressed for the day.

It is none of our business but mother must be a hardy soul.

WMAQ Moves

Station WMAQ, which has been located on the Fair Store building, Chicago, has been removed to the La Salle Hotel. Three big Chicago hotels have now added radio broadcasting stations to their activities, The Drake, the Edgewater Beach and the LaSalle. A hotel station has the advantage of an orchestra available each evening for jazz stuff.



The Hopwood circuit, showing the unusual connections of the instruments used.

Storing the Battery

Now that summer is approaching, there may be some who will not use the regular six-volt storage battery but use the dry cell ones instead. If you are contemplating doing this, take the advice of the battery expert in the Crosley Manufacturing Company's laboratory and do the following things:

Charge the 6-volt battery to its usual full capacity.

Drain the cells of their liquid.

Place the liquid in an airtight receptacle.

Be careful not to spill the liquid, as it will destroy clothing, rugs, etc. When ready to use again, divide the liquid into three parts and pour into the battery cells, proportionately, and fill up the cells until the plates are covered with distilled water, and then recharge.

Radio as a Teacher

French-speaking residents of Canada are learning English from the announcers of WGY, according to a letter received recently by the Schenectady radio broadcasting station of the General Electric Company.

Mrs. R. Normandin, a resident of Shawinigan Falls, Quebec, writes, "Many persons are taking advantage of radio to learn to pronounce English, especially from your station. Our daughter, aged four, speaks French only, and she startled us recently when she said all of a sudden, 'WGY, Schenectady, N. Y., one minute, please.'"

Those in charge of radio broadcasting activities of the General Electric Company realize that the right to broadcast carries with it the responsibility to offer something worth while. An earnest and conscientious effort is made to provide good music, to give variety of entertainment and to give helpful addresses. Announcers strive to pronounce all words correctly. Before an announcement is made or an address delivered, the announcer goes over the manuscript.

National Transformer

Construction of this audio-frequency amplifying transformer is very rugged and neat. The shell type of construction is used, the core being made of laminated silicon steel. The coils are neatly wound and impregnated, with connections to the posts well soldered.

The instrument is completely inclosed in a highly nickelplated case, held together by two nuts and bolts, and nickeled binding posts for the connections are plainly marked.

Extensions of the case in the form of feet are provided for mounting purposes. The transformer has a ratio of three and one-half to one and operates very satisfactorily, both as to volume and quality of amplification. The approximate over-all dimensions are 2⅜x2x2½ inches.

It is approved by the Radio Age Institute experts.

It is manufactured by the National Transformer Manufacturing Company, 154 Whiting Street, Chicago, Ill.

Erla Contest

In order to give all readers of Radio Age an opportunity to compete in the Erla prize contest, announced in the July issue of the publication, the closing date for this contest has been extended to August 10. Winners of the contest will be announced in the September issue.

For those who missed the June issue, the Erla contest offers for the best explanation of the action of the Erla Duo-Reflex circuit, one Erla Duo-Reflex receiver, mounted in a beautiful mahogany cabinet. For each of the ten next best explanations, one Erla Reflex transformer will be awarded.

Judges of the contest are F. D. Pearne, Technical Editor of Radio Age and E. J. Wiggins, Chief Engineer of the Electrical Research laboratories. Instructions for building the Duo-Reflex circuit may be obtained from any leading radio dealer or the Electrical Research laboratories, by writing for Bulletin No. 13.

Amateurs Increase

Washington, D. C.—Lest some fans believe that the reception of broadcasts is the only popular phase of the radio art, be it known that amateurs are still entering the game of "key pounding" at the rate of nearly three hundred a month. Since January 1, 1,334 amateur licenses have been granted by the Department of Commerce, and on June 5, there were 18,232 such stations in the United States.

The distribution of amateur stations by Districts June 5, was as follows:

District	Headquarters	Total
1	Boston	2,490
2	New York	2,629
3	Baltimore	1,994
4	Norfolk	444
5	New Orleans	941
6	San Francisco	2,172
7	Seattle	901
8	Detroit	2,932
9	Chicago	3,729
Total		18,232

The above table does not include special amateurs, of which class there are 201, no new licenses having been issued recently. It has been decided by the department that hereafter district radio supervisors will issue special amateur station licenses instead of the Washington office.

The waves assigned to special amateurs are between 150 and 220 meters for use in CW telegraph. Regular amateurs operate on 150 to 200 meters.

New Tubes for Old

W. C. White, of the research laboratory of the General Electric Co., made an address from WGY recently in which he announced that the company was making a collection of tubes and offering new tubes for old ones which were different enough from present tubes to be of value as a part of the collection.

This is what Mr. White said:

"For some time past, we have been making a collection of vacuum tubes to illustrate the development of this interesting art. A number of years from now such a collection will be of great interest and of considerable historical value.

"We would like to ask radio fans to assist us in making more complete this vacuum tube collection.

"It is natural, however, that we are only desirous of obtaining additions to this collection and, therefore, are interested only in tubes of other than General Electric manufacture. What we desire to obtain are tubes of very early manufacture, tubes of unusual design and those of other countries, particularly Italian, Japanese and German. It is not essential that these tubes be in operating condition. The filament may be burned out or the vacuum impaired, but they should be in satisfactory mechanical condition.

"If any radio fan has such vacuum tubes, I shall be very glad to have them write me, describing their tubes briefly and if they form an addition to our collection we will write their present owners offering them on receipt of their tubes to send them in exchange for each one of interest to us, one of the new UV-199 radiotron tubes. We will also include a socket for each tube and complete operating instructions. Address all communications relative to tubes of possible interest to us for this collection to WGY, General Electric Company, Schenectady, New York.

"It is particularly requested that any who have such tubes should write first and wait for a letter from us before shipping their tubes to us to learn whether they have any historical interest as an addition to our collection."

Records by Cruiser

Washington, D. C.—Naval radio experts are delighted with the performance of the radio equipment on the new scout cruiser, Omaha, which recently broke all long distance records in transmitting during her shake-down cruise in the Pacific.

While maneuvering at sea, off the coast of Washington, the newly installed radio transmitting sets were given a thorough test. Code messages transmitted with the 20 KW arc set, such as the larger naval craft are now equipped with, were copied by all naval radio stations along the west coast, from lower California to Saint Paul, Alaska, and on the East coast at Bar Harbor, Me., Washington, D. C. and Key West, Fla. One of the stations reached was San Diego, 1,800 miles away from the Omaha. This new cruiser's arc was copied by the battleship, California, which was 1,800 miles distant, but it is reported that she could not pick up the California's replies.

Not only in code dispatches did the Omaha's radio experts excel, but with her 300-watt tube set, spoken messages were transmitted to Pearl Harbor, Honolulu, 2,300 nautical miles distant. They were also heard at Key West, Fla., approximately 2,100 miles over land and sea.

Part of the credit for the long distance work is attributed to the 180-foot wooden masts, which carry the Omaha's aerials, almost fifty feet higher than the steel masts on battleships. The mean effective height on the Omaha is better than 100 feet, it is stated by naval experts. Her radio equipment is also installed on the top-side and not below, eliminating long cable and wire leads.

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BOOKS

If you have not bought your Reinartz Book, fully illustrated with hook-ups and clear description of how to make this popular circuit, send $1.50 in money order or check and we will send you the booklet "Reinartz Radio" and place you on the subscription list of Radio Age for six months. Address Radio Age, 500 N. Dearborn Street, Chicago, Ill.

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Radio Solder for construction and repairing radio outfits. Three six inch bars 25c postpaid. Hamilton Lead Company, Hamilton, Ohio.

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Please send me FREE one of your Reinartz Radio Books and send me Radio Age for one year. I want to take advantage of this Special Offer. I enclose $2.00.

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City.....

Street and Number.....

A New Bug

By ROBERT J. STANTON

Since the flea was found to be the fastest thing on legs and to have a strong attachment to orphaned dogs, expert scientists, after thousands of years of patient labor, employing the search and seizure act, have succeeded in ferreting out from the dim recesses of swamp, forest and jungle a veritable myriad of bugs.

Two years ago, the latest triumphant discovery of these insect chasers, who are said to be even more expert with a net than the saltiest fisherman of Newfoundland, was the golf bug. The larvae of this bug was found to be the male human, with more stomach than hair, and more time to kill than work to do. The habitat of the specie was a vast acreage of well-kept turf, dotted here and there with shell holes, ponds of water, and other topographical irregularities, which science found to be necessary in the complete formation of the adult bug.

After its emergence from the larva stage, the golf bug flies around the well-preserved turf, usually confining his jaunts from the colony to late afternoons and Sundays, in spite of vigorous protests from the female species. The female is the protector of the home and does all the work, and sees the male bug only on very rare occasions during the summer months. The habits of the male of the species, during the winter, are as yet unknown, due to its exceeding ferocity during this period. However, it has been found that a few migrate to the southern part of the country in November and fly north again in May.

The latest discovery of science in the world of insects, however, occurred about a year and a half ago, when an expert, searching in the vicinity of Pittsburgh, found a radio bug. The insect was a male adult, having a close resemblance to the golf bug, except for larger ears and a marked increase in the size of the finger tips.

Noting these two peculiarities, the scientist patiently studied his new discovery from concealment and learned that the enlarged ears were due to the bug's habit of clamping a pair of round black discs to his head, the discs resting tightly over the ears, spreading them out to a considerable extent. The enlarged finger tips were due to a continual twisting of several knobs on the front of an oblong-shaped box to which the black discs were attached by a green cord. Small lights in the box glowed dull red and occasionally the glow would cease, causing the bug to become greatly enraged.

Another peculiar characteristic of the new bug is its strange chatter, of which the major note sounds somewhat like KYW, KDKA, heterodyne, regenerative, frequency and tuning in. Several months after the discovery of the first bug, the scientists found that the entire country was literally infested with vast hordes of these bugs, and learned that whenever two of them were together, and one of them made the tuning in noise, a quarrel usually resulted which occasionally lead to serious injuries.

A radio bug does not spend all its time around the box with the cord and discs, however, as it is seen climbing around the roof of its home during a greater portion of the day. Some of the bugs are very agile in climbing slender poles attached to the top of their homes and adjusting wires suspended from them. The larger bugs do not seem to have this agility, however, and often fall to the roof amid wild howls.

After much research scientists have found that the Westinghouse Electric & Manufacturing Company was responsible for the huge swarm of these bugs, which now infest the United States. Other companies also operate the same kind of laboratories used by the Westinghouse company, which inoculate the air with a substance on which the bugs thrive.

Radio station 9-CEX, with a range of from fifty to seventy-five miles. **It was made by E. W. Applebaum, of the Illinois Fixture & Electric Supply Co., Chicago, and is said to be the smallest licensed and registered radio station. (U&U Foto).**

Operates in Duplex

Highly gratifying results have been secured with a new model high-power tube transmitter installed on the battleship, Wyoming, and used in regular traffic.

"In fact," states a naval report, "some results were unexpected, such as ability to receive on the same vessel, during full power operation of this tube, rating about 5KW." Numerous broadcasting stations transmitting on 400 meters were tuned in in the auxiliary radio room, while the big transmitter, installed in the main radio room, was supplying thirty-six amperes to the main antenna on a wave length of 507 meters. The receiving set in the auxiliary room was equipped with an amplifier, consisting of three stages of radio-frequency and two stages of audio-frequency.

"This condition allows duplex communication, which has actually been put in practice on the Wyoming and will be further developed on the Colorado and West Virginia," the report states.

"Radio Central"

By CARL H. BUTMAN

Washington, D. C.—The sign over the door reads: "Radio Central—No Admittance," but accredited correspondents may look around the new radio central office of the Naval Communication service in Washington, if they keep quiet.

It is located in the big naval building at Nineteenth and B Streets, near the Lincoln Memorial—sixth wing, second floor rear, to be exact—and is approached through the several offices of the Communication service, one of which is that of Rear Admiral Ziegmeier.

From this office issue all naval radio messages from the capital, the transmitters at Arlington, Annapolis, Sayville, and several smaller stations are controlled directly from keys installed here. Annapolis and Sayville are high-powered, trans-continental and trans-oceanic stations, and Arlington, which is a link in the long costal chain, is used for medium distant communication with Norfolk, Charleston, Key West, New Orleans and Guantanamo and ships at sea, over spark, arc and tube sets.

Long distance reception from the many outlying stations of the naval chain is secured through six big receiving sets, known as RB type tube receivers, located in six separate rooms in different sections on the third floor of the naval building. From these sets, leads run to the central switchboard and as many operating desks in the central office. The RB receivers pick up the messages on eight-foot loops installed directly overhead on the roof of the building. These coils are directional and may be rotated from the rooms below by a rod when tuning in. Each set is put in operation, watched and shut down by a monitor engineer who makes continual rounds of the six separate rooms. A continuous watch is kept on these large sets, each covering a special station. One listens in on San Diego on 9,800 meters; another for San Francisco on 10,500; a third on San Juan on 8,785; a fourth for Balboa on 7,000; number five on French stations on 15,000 and number six is used for emergency, and experimental work and ships. Each inside wire leads from the switchboard to the operator's desk, where phones, typewriters and transmitting keys are installed.

The efforts of the naval communication service are for reliabilty and efficiency in handling messages, and the sets and operators work on certain circuits all the time.

Two shorter wave sets, of SE 1420-C type, are installed in the central office, being connected with aerials on the roof above. These sets are used for receiving neighboring stations and ships on the Atlantic.

In Radio Central a busy scene confronts a visitor; some keys are clicking and some of the operators are typing messages from distant stations. Messengers come and go with dispatches from Government Officials to our representatives in foreign countries and our ships in the seven seas.

The long land line formerly used between the old receiving station at Bar Harbor and the Washington office, has been discontinued at a large annual saving. Bar Harbor is now a coastal and compass station and handles no long distance messages, although the equipment is left in place in the event of emergencies or war requirements. Washington is literally the naval radio central for the country today.

Radio at Shrine Convention

Radio, like practically every other activity, took part in entertaining the Shriners at the Nation's Capital last week. Among the features was the reception and amplification by a receiver in the Garden of Allah of a broadcast message from the President read by an aviator in a plane flying over the parade.

A local engineer installed a receiving set and a large loud speaker on the roof of the Albee Building. This apparatus amplified music and other matter picked up from nearby broadcasters.

Part of the Army's night parade exhibit was the miniature radio controlled cart, made by the Dayton Air Station, which was operated from an auto some distance in the rear.

NAA put on special programs for local consumption and events scheduled for the convention were broadcasted on opening day.

Many visitors were fooled by the loud speakers, erected along the Avenue by the local telephone company for amplifying dance music played in an auditorium and relayed by wire to the many horns; it sounded something like radio but was actually wire telephonic transmission from local sources.

Proper Antenna for Tuning

(Continued from page 8.)

distant one, the signal from which would, of course, be very much weaker than that from the nearby station. For the first condition, it will be found that with the average regenerative receiver, ample strength will be obtained from an antenna which is not over ten or fifteen feet high, or it may even be entirely within an ordinary living-room. The second condition, however, is a much more severe one and requires either a location where antenna of not over fifteen or twenty feet high will not be unduly shielded, or where the lesser selectivity of a high antenna will be counter-balanced by a more elaborate and selective receiving set.

CHARGE YOUR BATTERY
(RADIO OR AUTO)
at HOME for a NICKEL
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WHY TAKE CHANCES WITH INFERIOR APPARATUS?

The successful operation of your set depends largely on the quality of the parts used in it. One poor part may mean trouble and the quality of every part used should be carefully investigated before buying.

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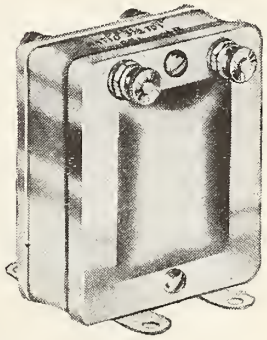

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When buying transformers be sure you get **National.** This transformer has a long successful record behind it. It has been tested by Mr. F. D. Pearne of the Radio Age Institute and many other leading radio authorities in laboratories throughout the country and has been approved by them as being a product which they are willing to recommend to those wishing a high quality transformer. You are therefore playing safe when you use the **National** in your set.

Give equally good results in any circuit wherever an audio frequency transformer is to be used. Can be used on any stage of amplification and with any type of tube.

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Get them from your dealer. If he hasn't them in stock send your order direct to us giving your dealer's name.

NATIONAL TRANSFORMER MANUFACTURING CO.

154 Whiting St. Chicago, Ill.

Old Doctor Radio

"Doctor, I'm so restless. Can't I have something to put me to sleep?"

"Certainly, but not morphine. Let's try a concert instead."

The doctor fixes a headpiece over the patient's ears, tunes up the radio to catch any music that may be in the air anywhere from New Hampshire to Arizona, and bids the suffering one goodnight.

Interest, enjoyment and drowsiness come. Then sleep. Radio has acted as a soothing syrup, as a narcotic. It has taken the place of a sleeping potion.

Such a picture will be a common one in Beth Israel Hospital down on the East Side in a very few days.

Radio receiving sets are being installed beside every one of the 150 beds in the first known attempt to substitute harmless air music for narcotics.

The attempt is a recognition of the importance of radio to the medical science.

And the very poor of New York's teeming thousands, men and women and children who can't afford to pay for a doctor, will get the benefit of this newest of hospital innovations.

Louis J. Frank, superintendent of the institution, is keen on the idea. He said today:

"Radio is bound to reduce the use of narcotics, as we expect to operate it here. It will have the effect of taking the patients' minds off themselves. That will reduce nervousness, wakefulness and pain.

"Staring at blank walls during illness and convalescence is enough to drive one mad. Certainly it does not make for rapid recovery. Books help some to divert the mind, but music fixes the attention and interest and finally lulls one to sleep."

The sets will be powerful enough to catch music from any part of the country. And at no hour of the day or night will there be a dull radio moment, if the instruments are in tune. Mr. Frank said:

"The medical profession is getting further and further away from the use of drugs. There are all sorts of treatments for various diseases that do not include medicines. And we are sure that our experiment in the radio soothing syrup will be a decided step forward in the same direction."

Headpieces instead of horns will be used so that each patient may have his individual concert without disturbing any of the others. There are only wards in Beth Israel and a horn of the old phonograph variety placed among twenty or thirty persons would arrest the attention of them all, sometimes with unpleasant results.

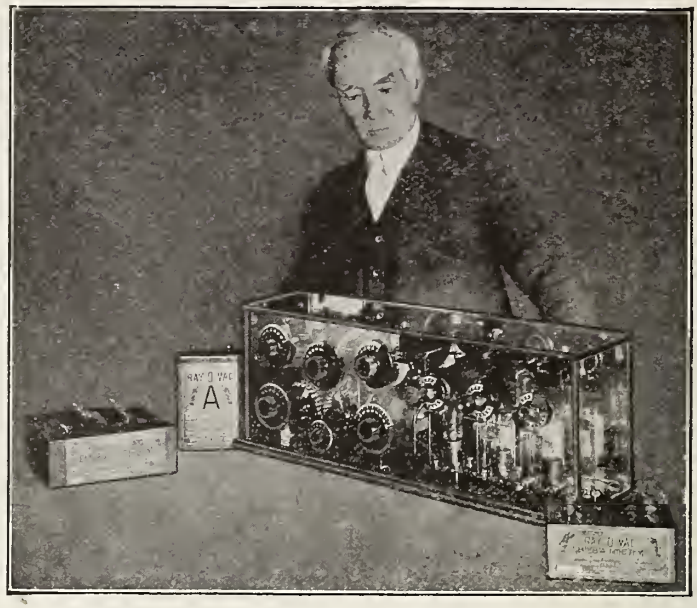
Mr. Frank explained:

"There will really be two receiving sets by each bed," Mr. Frank said, "so that each patient may exercise choice over the selection of a programme."

Meanwhile, the present patients in the institution are hoping they will still be there when the first concert is caught. And hospitals over the country are waiting for news of the result of the experiment.

They are anxious to know what amount of narcotics will be eliminated.—[Corrinne Rich in New York American.

Receiver Enclosed in Glass



THE French Battery and Carbon Company has the distinction of having in its employ Chief Designer John Graves, who has conceived and built a radio receiving set of glass with two steps of audio frequency. The set operates with 3 WD-11 tubes on a Number 1261B Ray-O-Vac "A" Battery and 3 No. 2151 Ray-O-Vac "B" Batteries on the plate circuit.

This unusual set of glass is the eighth radio set Mr. Graves has built. Several years ago when radio was first coming into general use, Mr. Graves designed and built a set with the navy type loose coupler and a Remler Detector Panel. With this set only a very few stations were heard, chief among them being the University of Wisconsin Broadcasting station at Madison.

Following sets were fashioned with the other "hook-up" all of them being of two steps of audio frequency. Fellow workers at the French Battery and Carbon Company were fortunate in having Mr. Graves build sets for their use, all of them operating perfectly today.

The idea for the building of his glass set springs from Mr. Graves' association several years ago with a business in Milwaukee which made glass window display fixtures. "It was while attempting to cut down the expense of drilling holes through the plate glass used in making these fixtures," states Mr. Graves, "that I discovered a solution, through the use of which, I could drill these holes myself without danger of breaking the plates and at one-tenth the previous cost. With my solution, plate glass can be put into a lathe, if necessary and turned without danger of breakage. It holds the edge of the tool to the glass and makes a clean cut job."

There are 54 holes drilled through th glass used in the set varying in diamet e from 3-16 to 3-8 of an inch. Each h er required from 10 to 12 minutes for drilling. Ordinary twist drills were used. The set is 26 inches long, 9 inches high and 6 inches deep.

With the set Mr. Graves reports having tuned into more than one hundred and fifty stations among them being the largest stations in the United States, Canada, Cuba and Porto Rico.—[Ray-O-Lite News.

Vienna Station

The Marconi Company has taken over the Austrian Government radio station at Laaerburg, just outside of Vienna. This has necessitated negotiations between that company and representatives of the Naval Communication Service, regarding charges for traffic handled in the future for the Naval Communication Service. This station has formed since the war, a link in the naval communication service in Europe, from Paris to Constantinople.

Naval Operators

Very few naval officers assigned to communication duties are efficient radio operators, according to naval records. An officer assigned to such duty should consider it his first duty to learn at once the code, and after mastering it, a few hours listening in each day with an experienced operator, will soon enable him to operate. Only by this method can an officer acquire firsthand information regarding the efficiency of his operators in transmitting and in the observance of procedure, communication, officials say.

Send $1.00 to Radio Age, 500 N. Dearborn St., Chicago, and receive this middle-west radio periodical for six months. Regular subscription price is $2.50 a year.

What Does the Radio Public Want?

By WILLIAM H. EASTON

Westinghouse Electric & Manufacturing Company

IF THE radio audience could realize some of the problems that have to be solved by those who are engaged in preparing the programs, they would, I am sure, not only sympathize with them but would wonder how they preserve their sanity. No one before has ever had to entertain a million or so people every night; and consequently those who have undertaken this simple little task have had to stumble along as best they could learning as they go and profiting wherever possible by their mistakes. They are, however, exceedingly fortunate in having an audience that tells them frankly just what it thinks about their efforts; and with the hundreds of letters that reach them daily as a guide they have been able to work with some degree of certainty.

The first rule that the letters lay down is: Give the radio public infinite variety. If you were to open their mail some morning, the first letter would probably say, "I enjoyed your concert so much last night. That's right; give us more good music and do away with those execrable popular selections." Then the second letter would say, "For the love of Mike, cut out the Uproar and give us good old American Jazz." Letter number three would read as follows: "Prof. Simpkins' address on the Color of Cats was the most interesting speech I ever listened to"; and letter number four would state, "Why do you afflict your audience with such stupid stuff as the talk on cats? I hung up my receiver in disgust."

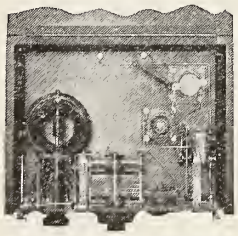
With testimony like this it is quite evident that it is very difficult to satisfy everybody all the time. The only thing to be done, is to draw from the entire field of music, literature, science, politics, culture, hygiene, and religion, and thus please everyone at least part of the time. Consequently, those who do not like jazz music must bear in mind that many will listen to nothing else; while those who do not like speeches must remember that a very large number of radio listeners are isolated or are invalids, and absolutely depend upon radio for their contact with the outside world.

The second point that the letters prove is, there must be constant improvement in broadcasting both technically and artistically. No station can maintain its programs on a dead level and retain the interest of its audience. The complaints soon begin to come in. Curiously enough, they are all to the effect that the programs are getting so poor. This is not the case. They are just as good as ever; but the taste of the audience has improved. It is for this reason that KDKA is experimenting so constantly in every direction. Its engineers are incessantly striving for better tone reproduction and for the elimination of unpleasant noises. Its program staff is incessantly working for better artistic effects and for entirely new features. They began with the phonograph; then introduced artists and speakers in person; then went outside of the studio for church services, important meetings, symphony concerts, operas, and sporting events; and recently established an orchestra so that incidental music could be rendered in the best possible manner. Thus, in accordance with the well-known formula, "Every day in every way we are getting better and better." But no one realizes more fully how much more must be done in order to continue to preserve the good opinion of the radio audience.

The third important fact that develops from the correspondence is, interference must be eliminated. Not only must the audience be able to hear this station clearly and distinctly whenever they wish to hear it, but they must also be at perfect liberty to eliminate its signals and receive equally clearly the program to some other station that may, for the moment, please them better. This is their most serious problem at present.

The great increase in the number of stations has filled the other with chaos and confusion and if this is not remedied broadcasting will die out. The government, the radio engineers, and those broadcasting stations that are interested in radio for

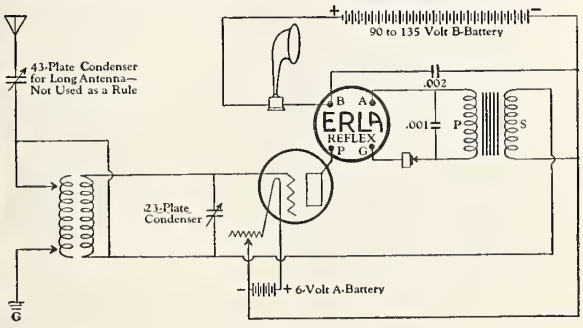
How to Get the Most Out of One Tube



Duo-Reflex simplicity assures neat, compact, cabinet installation. Detailed blue prints are on sale by dealers at 25c per set

Erla radio frequency transformers maintain unequaled amplification over a wave-band of 200 to 900 meters. AB 1, 2, 3, $4. Reflex, $5

Dealers and Jobbers—Erla leadership in research paves the way to increased sales. Jobbers—write for our liberal terms and discounts



Use Duo-Reflex Hook-Up and Erla Transformers

You will never know the full range and power of a single tube until you have operated Duo-Reflex, the most powerful single-tube circuit ever built.

Under conditions at all favorable, a wide compass of stations is brought in through a loud speaker, and headphones extend the range from coast to coast.

Especially designed for Duo-Reflex, and the major essential of its power is the Erla radio frequency reflex transformer, one of the greatest improvements in years.

Complete instructions for building Duo-Reflex are given in Erla Bulletin No. 13, obtainable gratis from leading radio dealers. Or write us, giving your dealer's name.

ERLA Electrical Research Laboratories
Dept. M 2515 Michigan Ave., Chicago

its own sake, and not for selfish reasons, are struggling with it valiantly. Though the situation may at times look hopeless, one should not forget that worse troubles than this have been smoothed out.

Broadcasting is only an infant. If it develops as rapidly within the next two years as it has in the past two (and there is every reason to believe that it will) interference will disappear; trivial programs will make way for those of real interest and importance; and it will be possible to hear not only the large American stations, clearly and distinctly, almost anywhere in the United States, but stations in London, Paris and Rome as well.

Cornered by Radio

Radio has invaded the country grocery store. Round-the-stove conferences, once devoted to the discussion of national political issues, have been suspended in favor of radio broadcast entertainment, addresses and sermons.

A sermon delivered by the Rev. Dr. Philip Frick, pastor of the First Methodist Church in Schenectady, N. Y., was broadcast by WGY, the General Electric Company station. Dr. Frick received the following letter from "Bill" Davenport, of Hillside Farm, Jefferson, New Hampshire:

"My Dear Sir:

"You will see by the heading of this letter, I am 'way up in the White Hills, right under Mount Washington. Today, Sunday, I had occasion to go to the store of F. O. Giddon and while there I heard a sermon preached by you, which I enjoyed very much. In fact it is the first one I have heard in thirty-five years. So you will see I am not much of a churchgoer, and to think you, away off in New York, should be the first one to catch me. The sermon was very distinct and the singing was fine. In our little town we have three churches, but there are quite a few of us old hardshells who rather go to the store and discuss whatever has transpired through the week.

"I just wish you could have looked in on the bunch while you were preaching. We were all held spellbound. You could have heard a pin drop anywhere in the room.

"Hope you will not think we all are heathens up here in the mountains. I should be very glad, if you ever came this way, to have you for my guest for a few days. Hoping that I may be able to hear another one of your sermons, I remain——."

ZiegemeierTransferred

Rear Admiral Henry J. Zeigemeier, Director of Naval Communications, and one of the foremost experts of the navy, has been detailed to command the Norfolk navy yard. His successor as Director of Naval Communications has not been named, but it is stated that Commander D. C. Bingham, Assistant Director, will be acting chief.

Uncle Joe Cannon a Radio Fan

Uncle Joe Cannon, listening to his first concert on his new radio set given to him by the Westinghouse Company on his 87th birthday.

OUT of politics forever and back to the routine of his old home town, Uncle Joe Cannon, Speaker in the House of Representatives for many years, will keep in touch with the outside world by means of radio and learn what the law makers at Washington are doing. He became a fan when the Westinghouse Electric & Manufacturing Company presented him with a complete radio set on the occasion of his eighty-seventh birthday which was celebrated in Danville, Ill., on May 7. The outfit has been installed in his home and he is already a constant listener to the programs broadcasted all over the country. After the set was installed and Uncle Joe was instructed on its operation he immediately settled down to enjoy its use.

Mr. Cannon listened for a time and then said: "There's an effort on the part of someone to talk and an effort on the part of my ears to hear, but nothing else."

He was shown how to make finer adjustments, caught voices then music, grand opera.

"That's better," he said, crossing his legs settling more comfortably in his chair and enjoying it for some time. He gave every indication of becoming a real radio fan.

"That woman has a good voice, yes, a remarkable voice hasn't she?" he inquired of a group of newspaper men, camera men and members of his family gathered near him. Then he smiled as he realized that none but he had heard.

"What was it, grand opera?" inquired one of the newspaper men.

"—es," replied Mr. Cannon, "I think that's what you would call it. It was very good."

Although the radio set was only one of a number of gifts received by Uncle Joe, he seemed to take the most pride in his radio set.

The set was installed on his birthday by C. E. Butler radio service manager of the Westinghouse Chicago office who made a special trip to Danville to see that the set was properly erected.

Radio Letters from Latvia

The Latvian Main Post and Telegraph Administration announces that radio letters to the United States may be filed at all Latvian telegraph offices. The letters will be mailed to Berlin, whence they will be transmitted by wireless to New York, and from there to the addresses by post.

The letters must contain text in English, French or German.

The charges for radio letters are 35 centimes per word, plus 1 lat (equal to 1 French franc) ground fee per wire.

Prices Too High

American radio manufacturers ask too much for their radio apparatus and materials to secure the Dutch trade, according to Consul Mahin, at Amsterdam. Competition from other countries, especially Germany, is reported to prohibit Dutch interests doing business with American exporters although the demand for radio telephone sets is good in Holland.

Wireless Phone, Ship to Shore

The United Steamship Company of Copenhagen, Denmark, plans to install wireless telephone equipment on all boats plying between Copenhagen and the provincial harbors for the traveling public's convenience. Travelers will be able to secure direct communication, through the land telephone service, with their own homes or offices, similar to the service planned for the U. S. Ship LEVIATHAN.

Canary Islands Considering Wireless

Vice Consul Phelan, in the Canary Islands, reports active discussion in the Cabildo Insular de Teneriffe of a proposal to establish in the near future wireless telephone stations at the various islands of the Archipelago. The present cable service between the islands has been very inefficient and has given rise to the suggestion of using wireless telephony.

Radio Pays a Debt

Radio has paid part of the debt which it owes to the genius of E. F. W. Alexanderson, chief engineer of the Radio Corporation of America and a consulting engineer of the General Electric Company.

Monday, April 30, Verner, six-year-old son of Dr. Alexanderson, was lured from his home by the promise of a gift of rabbits, and kidnapped. The police had practically no clues on which to work; in spite of the active work and close cooperation of newspapers, police and radio broadcasting stations, the case appeared to be at a standstill and the whereabouts of the boy remained a mystery for three days.

Bert Jarvis, of Theresa, a Jefferson County, N. Y., village of a thousand inhabitants, listening in Monday night on his homemade radio set, heard WGY, the Schenectady radio broadcasting station of the General Electric Company, announce the kidnapping. Jarvis rents boats to fishermen and acts as caretaker for numerous summer cottages in the vicinity of Theresa. A few days before the kidnapping he had rented an isolated cottage to a man who was bringing his family up from the city for the season.

After hearing the radio description of missing boy and kidnapper, Jarvis' suspicions were aroused. Tuesday, he met the owner of the cottage and asked him who had taken possession. The owner explained that it was only an old woman, a little boy and one man.

It so happened that the man, when renting the cottage, had said he was going to bring his daughter. Jarvis' suspicions grew, and Wednesday he decided to ride out to the vicinity of the cottage in his motorboat. He stopped at the cottage and asked the old woman who came to the door for a drink of water. He entered the house and saw a child on the bed. Jarvis returned to the cottage later and asked for candlewicking for his motor. On this visit he waved to the boy and the boy waved at him.

Thursday morning Jarvis saw a photograph of the kidnapped child in the Syracuse Post Standard and this picture tallied with the boy of the cottage. Now sure of his ground, he reported to the deputy sheriff and a few hours later Verner Alexanderson talked over the long distance telephone to his father and mother.

The successful use of radio in the Alexanderson case has convincingly proved the value of radio broadcasting as a publicity factor, when far-reaching results are desired in a short time. WGY announced the kidnapping within two hours after it had been reported to the police. Other broadcasting stations joined their voices to the voice of WGY, and the story, with descriptions of the missing boy and kidnapper, went out over the entire country. Radio fans everywhere were enlisted in the search. The newspapers kept them posted on the progress of the case and also furnished them with pictures of the boy. Through Hudson Maxim, the members of the Amateur Radio Relay League took up the case and hundreds of spark sets flashed the story through the air.

Dr. Alexanderson made a personal appeal from the Schenectady broadcasting station and after the boy had been found he again addressed the radio audience, thanking all for their interest, sympathy and assistance. He placed special emphasis on the cooperation of press and police.

Dr. Alexanderson has done much for radio, but the engineer feels that radio has more than repaid him for his work, for it has restored happiness to his home.

At Goteborg Fair

Radio will have an important place in the International Aero Exhibition at Goteborg, Sweden, during July and August, according to dispatches from Consul Sholes to the Department of Commerce. A special radio section is under preparation, and several foreign and American firms are expected to exhibit apparatus, especially radio sets suitable for interplane and plane to ground communication.

A feature of unusual interest will be the daily receipt of news by radio from the United States for the American visitors at the exposition. Through the cooperation of a Swedish-American News Association and the Naval Communication Service, NAA will broadcast daily five hundred words of home news.

Moving Trains

Germany recently had a demonstration of wireless telephonic communication between a moving train and ordinary receiving and transmitting stations, according to Consul Richardson, at Berlin. Messages were exchanged between the President and officials of the government in Berlin and other officials on a train, moving at thirty miles an hour, half-way between Berlin and Hamburg, by means of the Huth system. This system is a combination of wireless and wire transmission. The sending apparatus was installed in a compartment on the train and the antenna rigged over the tops of two cars. The line telegraph wires along the track are said to have picked up the messages and transmitted them to Berlin, where the line was connected with a receiving set.

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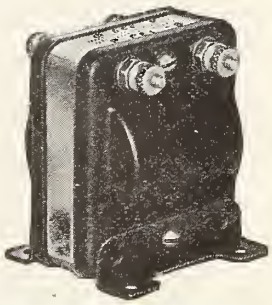

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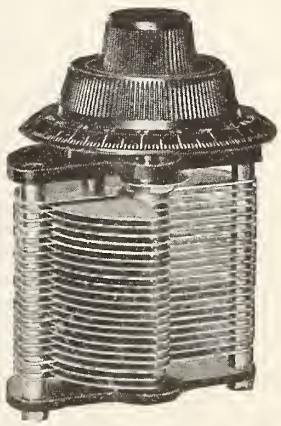

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Fooling the Broadcaster?

SOME snappy comments on the efforts of the music publishers and composers to make it appear that they really and truly believe broadcasting hurts the sale of their music are contained in a recent issue of "Gossip on The Rilato," of New York. The article follows:

"The broadcasters certainly are a fine bunch of dumbells. Here they are fightin' the society of composers, authors and publishers because the society is tryin' to pick some berries where berries ain't growin'. But the publishers are makin' boobs out o' them. They can give them broadcasters the best cards in the deck and still take the money. Now, this is the way it works:

"The broadcasters won't pay for singers and orchestras, so they go aroun' gettin' the kind of birds that performs for nothin' and think they're gettin' away with it. These publishers ain't asleep; they got their ears to the ground all the time. When a big broadcaster with a fat station wants a pretty, sweet-voiced singer to sing for nothin', who do you think appears on the scene? Why, likely as not some good lookin' outfit from the professional department of one of the big combinations. Does he say he is from a publisher? He does not. And what do we find this free service artist singin'? Why, the numbers that the publishers are pluggin'.

"Or maybe the orchestra leader says what dance music he's goin' to play. He don't hear them when the radios want their music shot out. And he's got a million reasons why he's goin' to play the music of the publishers' combination. The public wants it, etc., etc., he says. Now you don't need no two guesses what the real reason is.

"Take this 'banana' song. You know the one I mean, called 'Yes, we have no bananas.' It's one of them hit-and-get-away things that must be plugged in a hurry. What did we find all last week, and the week before? The only thing you could get out of the air was 'bananas.'

"It is certainly a great game, these publishers claimin' that radio don't popularize music, and then findin' an openin' in the broadcasters fightin' program and puttin' their own things over at the expense of the broadcasters, and then not knowin' it. These birds know that radio can work up a hit quicker than all their pluggers put together. You are goin' to see the publishers fallin' one at a time. They will pay to have their things plugged through the air before they get through.

"It makes me laugh to see the way they work. First they are goin' to make the broadcasters pay. Yes, they are—not. Try and get it. Then they offer licenses free. And they sneak in their professionals on radio programs. Well, it is only a step to come out in the open and ask to have their stuff plugged over the air, and I bet my last dollar that if these broadcasters don't fall asleep they will be collectin' from the publishers instead of payin' them.

"Why, even now two of the big ones are tellin' their professional department to get ready; that they got to go aroun' the country puttin' on programs for broadcasters. Of course they will make it look like they are doin' the radio men a big favor. It's a sacrifice bunt they're goin' to try to turn into a two-bagger. It's fun to watch the plugs. They've bluffed a few radios. But the wise guys ain't bein' bluffed a-tall, a-tall. They make bums of song writers but I'm bettin' my last bean they ain't goin' to make no bum out of a radio."

Fans Hit a Snag

Many radio broadcasting fans have been experiencing difficulty in tuning in stations since the reallocation of wave lengths on May 15.

It is not surprising that trouble of this kind has arisen among many of the listeners, who had become quite proficient in tuning to the old wave lengths used by the various stations. In some instances, the difficulty lies in the receiving sets, with which the trouble is being experienced, and many of them will have to have additional wire added to the tuning coils in order to reach the longer waves now being used by some of the stations.

In spite of the difficulty that some are having, it is certain that after the radio fans have become accustomed to tuning for the new wave lengths, the service will be more satisfactory than ever before.

Some of the stations using higher wave lengths are: WOC, Davenport, Iowa; KIF, Los Angeles, Calif.; KGW, Portland, Ore.; KPO, San Francisco, Calif.; KFDB, San Francisco, Calif.; WCX, Detroit, Mich.; WGM, Atlanta, Ga.; WHB, Kansas City, Mo.; WIP, Philadelphia, Pa.; WJZ, New York City; WMC, Memphis, Tenn.; WBAP, Ft. Worth, Texas; WCAE, Pittsburgh, Pa.; WDAF, Kansas City, Mo.; WEAF, New York City; WFAA, Dallas, Texas; WJAZ, Chicago, Ill.; WLAG, Minneapolis, Minn.; WMAQ, Chicgo, Ill.; WSB, Atlanta, Ga., and WWV, Detroit, Michigan.

Unique Exhibit

"Taking Broadway with him," was well illustrated by a recent exhibit which Lyon and Healy had at the Outdoor and Sportsman show at the Coliseum, in Chicago, during May.

The Chicago music house used an elaborate setting, which was a reproduction of a bit of woodland scenery. The effect was very artistically worked out.

An interesting feature of the display was a twelve-foot waterfall. This fed the miniature stream illustrated.

The dummy of the sportsman attracted favorable comment from men who know the joys of fishing

The exhibit was given over to radio. Lyon and Healy displayed its new portable outfit and got over very effectively its sales message

592 Broadcasters

Washington, D. C.—Radio broadcasting stations total 592, according to a recent Department of Commerce survey. Of this number, 113 are class A stations, thirty-six high-powered class B stations, 1 KDKA, designated as a broadcasting development station, and the balance, 442, class C, operating on 360 meters.

Many old stations grouped temporarily as class C and directed to operate only on 360 meters, have been reclassified as A stations and assigned special district waves. There remain 442 in this class today, either awaiting new wave lengths or satisfied to continue on 360 meters. New stations, however, are still coming in, about thirty being added in the last thirty days, while twenty dropped out.

During the week ending May 28, four new A stations were licensed; one each in Pennsylvania and South Dakota, and two in Colorado. Fourteen C stations were transferred from class C during the week ending May 26.

Here's Evidence

The Radio Age:

Am just in receipt of the June number of Radio Age. I notice with particular interest the article in "Thought Waves from the Editorial Tower" an article regarding Mr. Wendell Hall, and also the expression of The American Society of Composers, Authors and Publishers, in that radio does not create a demand for the songs and musical compositions.

The writer happened to have a few of his friends in one evening, perhaps two or three months ago and we were listening to a very nice concert from KYW, Chicago. That evening we heard Mr. Hall sing his "Mellow Moon," and I believe one other piece; I don't remember the name. However, that was the first time any of us had heard that particular piece, and I personally know that it caused the sale of three Edison records and five copies for the piano, just from our own home that evening. It seems to me that this is conclusive proof that the radio absolutely sold every one of these numbers. (It might have been Mr. Hall's *voice*, however, as it was just as good as if he had been in our own home.) Any way the sales were made through radio broadcast

Yours truly,
ALLEN TOOMEY,
Spearfish, S. Dak.

Mr. Haws to Europe

R. Calvert Haws, Vice President and General Manager of the Shuman-Haws Advertising Company, Chicago, is visiting England and the continent in order, primarily, to make a firsthand study of European radio industries and markets.

While abroad, he will secure European connections for radio clients of his agency and will also seek to arrange for American outlets for such meritorious European radio apparatus as he may encounter.

Complete Corrected List of U. S. and Canadian Broadcasting Stations

Complete Each Issue

THE list of broadcasting stations on these pages is brought up to date each month by additions of new stations and deletion of those which have suspended operation. The list is the product of a vast volume of correspondence and its completeness is due in large measure to the assistance of our special news service in Washington, D. C. Suggestions, corrections and additional data will be welcomed from readers. Broadcasters: Send in your program schedules.

Wave lengths assigned to stations by the Department of Commerce, so far as the announced, will be found in a table on another page.

IXAD, Pawtucket, R. I, 1000 miles; Special license experimental; Standard Radio & Electric Co.
KDKA, E. Pittsburg, Pa.; Class B station Westinghouse Elec. & Mfg Co.
KDOW, Steamship America, New York.
KDPM, Cleveland, Ohio; Westinghouse Elec. & Mfg. Co.
KDYL, Salt Lake City, Utah; news music, entertainment, Telegram Publishing Co.
KDYM, San Diego, Cal.; Savoy Theatre; 252 meters 100 watts.
KDYQ, Portland, Ore.; Oregon Inst. Technology.
KDYS, Great Falls, Mont.; Class B, Great Falls Tribune.
KDYW, Phoenix, Arizona; Smith Hughes & Co.
KDYX, Honolulu, T. H; 12:15 to 1:15 p. m., stock reports and weather; 6:30 to 7:30 p. m., music, lectures; Sunday, 11 a. m. to 12:30 p. m., sermons; Honolulu Star-Bulletin, Ltd.
KDZB, Bakersfield, Calif.; Frank E. Seiffert.
KDZE, Seattle, Wash.; Rhodea Co.
KDZF, Los Angeles, Calif.; Automobile Club of Southern California.
KDZG, San Francisco, Calif.; Cyrus Pierce & Co.
KDZI, Wenatchee, Wash.; Electric Supply Co.
KDZK, Reno, Nev. Wednesday 8 to 9 p m; Friday 8 to 9 p m. Musical and news features; Nevada State Journal, Nevada Machinery & Electric Co.
KDZQ, Denver, Colo. Pyle & Nichols, 1247 Broadway.
KDZR, Bellingham, Wash; 261 meters, 50 watts; Bellingham Pub. Co.
KDZX, San Francisco, Calif.; Glad Tidings Tabernacle.
KFAD, Phoenix Ariz.; Class B, McArthur Bros. Mercantile Co.
KFAE, Pullman, Wash.; State College of Washington.
KFAF, Denver, Colorado; George S. Walker, Western Radio Corporation; musical programs, news items, etc., daily except Tuesday and Sunday, 8 to 9 p m; mountain standard time.
KFAJ, Boulder, Colo.; University of Colorado.
KFAN, Moscow, Idaho; Electric Shop.
KFAP, Butte, Mont.; Standard Pub. Co.
KFAQ, San Jose, Calif.; City of San Jose.
KFAR, Hollywood, Calif.; Studio Lighting Service Co.
KFAT, Eugene, Ore. Monday, Wednesday and Saturday 8 to 9 p m Music; Sunday 8:30 to 9:15 Church Services; Pacific Radio Co.
KFAU, Boise, Idaho; Class B, Boise High School.
KFAV, Venice, Calif.; Abbott Kinney Co.
KFAW, Santa Anna, Calif.; Class B, Radio Den.
KFAY, Central Point, Ore.; W. J. Virgin Milling Co.
KFBB, Havre, Mont.; F. A. Buttrey & Co.
KFBC, San Diego, Calif.; W. K. Arbill.
KFBD, Hanford, Calif.; California Radio Lab.
KFBE, San Louis Obispo, Calif.; R. H. Horn.
KFBG, Tacoma, Wash.; First Presbyterian Church.
KFBH, Marshfield, Ore.; Thomas Musical Co.
KFBK, Sacramento, Calif., 2,000 miles; daily, 3 to 4 p m and 6 to 6:30 p m; Sunday and Thursday 8 to 9 p m; Kimball-Upson Co. and Sacramento Union.
KFBL, Everett, Wash.; Leese Bros.
KFBU, Laramis, Wyo.; N. S. Thomas.
KFBC, Phoenix, Ariz.; Nielson Radio Supply Co.
KFCD, Salem, Ore.; F. S. Bartin.
KFCF, Walla Walla, Wash.; Frank A. Moore.
KFCH, Billings, Mont.; Elec. Service Station.
KFCK, Colorado Springs, Colo.; Colorado Springs Radio Co.
KFCL, Los Angeles, Calif.; Los Angeles Union Stock Yards.
KFCM, Richmond, Calif., Richmond Radio Shop.
KFCQ, Casper, Wyo.; Motor Service Station.
KFCP, Ogden, Utah, Ralph W. Fygare.
KFCY, Houston, Tex., Fred Mahaffey, Jr.
KFCY, Le Mars, Ia.; Western Union College.
KFCZ, Omaha, Nebr.; Omaha Central High School.
KFDA, Baker, Ore.; Adler's Music Store.
KFDB, San Francisco, Calif.; Mercantile Trust Co.
KFDC, Spokane, Wash; Radio Supply Co; 283 meters; 10 watts.
KFDD, Boise, Idaho; St. Michael's Cathedral.
KFDO, Bozeman, Mont.; Everett H. Cutting.
KFDP, Des Moines, Ia.; Hawkeye Radio & Supply Co.
KFDS, San Francisco, Calif.; John D. McKee.
KFDU, Lincoln, Nebr; Nebraska Radio & Elect. Co.; 240 meters; 20 watts.
KFDV, Fayetteville, Ark.; Gilbreth & Stinson.
KFDY, Brookings, S. D.; South Dakota State College of Agriculture and Mechanical Arts.
KFDL, Denver, Colo.; Knight Campbell Music Co.
KFDJ, Corvallis, Ore.; Oregon Agri. College.
KFDC, Spokane, Wash.; Radio Supply Co.
KFDF, Casper, Wyo.; Wyoming Radio Corp.
KFDR, York, Nebraska; Bullock's Hardware & Sporting Goods.
KFDX, Shreveport, La.; First Baptist Church.
KFDZ, Minneapolis, Minn.; Harry O. Iverson.
KFEB, Taft, Calif.; City of Taft.
KFEC, Portland, Ore.; Meier & Frank Co.
KFEJ, Tacoma, Wash.; Guy Greason.
KFEL, Denver, Colo., Winner Radio Corp.
KFEP, Denver, Colo., Radio Equipment Co.
KFEQ, Oak Nebraska; J. L. Scroggin.
KFEQ, Oak, Nebraska; J. L. Scroggin.
KFER, Ft. Dodge, Iowa; 231 meters, 10 watts; Auto Electric Service Co.
KFEV, Douglas, Wyo; Radio Elect. Shop; 263 meters; 100 watts.
KFEX, Minneapolis, Minn; 261 meters, 100 watts Augsburg Seminary.
KFEY, Kellogg, Idaho; Bunker Hill & Sullivan Mining & Construction Co.
KFFZ, Dallas, Texas; 226 meters, 20 watts; A. G. Barnes Amusement Co.
KFEZ, St. Louis, Mo.; American Society of Mechanical Engineers.
KFFA, San Diego, Calif.; Dr. R. C. Shelton.
KFFE, Pendleton, Ore.; Eastern Oregon Radio Co.
KFFD, Hillsboro, Oregon; Dr. E. H. Smith.
KFFP, Moberly, Missouri; First Baptist Church.
KFFQ, Colorado Springs, Colo.. Marksheffel Motor Co.
KFFR, Sparks, Nev.; Jim Kirk.
KFFV, Lamoni, Iowa; Graceland College.
KFFX, Omaha, Neb; 278 meters, 250 watts; The McGraw Co.
KFFY, Alexandria, La; 275 meters; 100 watts; Pincus & Murphy Inc.
KFGB, Pueble, Co., Loewenthal Bro.
KFGC, Baton Rouge, La; 264 meters, 100 watts; Louisiana State University.
KFGD, Chickasha, Okla.; 248 meters, 20 watts; Chickasha Radio & Elect. Co.
KFGF, Mt. Vernon, Wash.; Buehanan, Stevens & Co.
KFGH, Stanford Univ., Calif.
KFGJ, St. Louis, Mo.; 266 meters, 100 watts; Nat'l Guarda Missouri 138 Infantry.
KFGL, Arlington, Oregon; Arlington Garage.
KFGP, Cheney, Kansas; 229 meters, 10 watts; Cheney Radio Company.
KFGQ, Boone, Iowa; 226 meters, 20 watts; Crary Hardware Co.
KFGV, Utica, Nebraska; 224 meters, 10 watts; Heldbreder Radio Supply Co.
KFGX, Orange, Texas; 250 meters; 500 watts; First Presbyterian Church.
KFGY, Baudette, Minn; 224 meters, 15 watts; Gjelhayg's Radio Shop.
KFGZ, Berrien Springs, Mich; 268 meters, 10 watts; Emmanuel Missionary College.
KFHA, Gunnison, Colo.; Colorado State Normal School.
KFHB, Hood River, Oregon; F. L. Boardwell.
KFHD, St. Joseph, Mo.; 226 meters, 10 watts; Utz Electric Co.
KFHF, Shreveport, La 266 meters, 150 watts; Central Christian Church.
KFHR, Seattle, Wash; Star Elect & Radio Co; 270 meters; 100 watts.
KFHH, Neah Bay, Wash.; Ambrose McCue.
KFHI, Wichita, Kansas; 224 meters, 20 watts; Charles V. Dixon.
KFHJ, Santa Barbara, Calif., Fallon Co.
KFHL, Oskaloosa, Ia.; 227 meters, 10 watts; Penn College.
KFHP, Kearney, Nebr; Radio Bug Products Co; 246 meters; 10 watts.
KFID, Iola, Kansas, 246 meters, 20 watts; Ross Arbuckle's Garage.
KFIQ, Yakima, Wash.; 224 meters, 50 watts; Yakima Valley Radio Broadcasting Association.
KFI, Los Angeles, Calif.; radius covers entire U. S. and Canada; Daily, 6:45 to 11 p. m. Sunday 10 to 11 a. m., 4 to 4:30 and 8 to 11 p. m.; entertainment and educational features; station operates three remote control stations: Earle C. Anthony, Inc.
KFIB, St. Louis, Mo.; 214 meters, 10 watts; Franklin W. Jenkins.
KFIF, Portland, Ore.; Benson Tech. Student Body.
KFIC, Denver, Colorado; 224 meters, 15 watts; Philip Laskowitz.
KFIJ, Platte, S. D.; Sidney I. Thorean; 236 meters; 5 watts.
KFIK, Gladbrook, Ia; Gladbrook Electric Co; 234 meters; 20 watts.
KFID, Spokane, Wash.; North Central High School; 252 meters; 50 watts.
KFJD, Greeley, Colo.; Weld County Printing & Publishing Co; 236 meters; 100 watts.
KFKH, Denver Park Amusement Co; Lakeside, Colo; 226 meters, 10 watts.
KFU, Gridley, Calif.; The Precision Shop.
KFZ, Spokane, Wash.; Doerr-Mitchell Elec. Co.
KGB, Tacoma, Wash., Sunday: 5 to 7:30; Daily: 7 to 9 p. m. (except Thursday) News, Sport bulletins, lectures, entertainment, weather, tide tablee, bedtime stories, time, etc.; Tacoma Daily Ledger station operated by the William A. Mullins Electric Co.
KGG, Portland, Ore.; Hallock & Watson Radio Service.
KGN, Portland, Ore.; Northwestern Radio Mfg. Co.
KGD, Altadena, Cal. 2500 miles; every Saturday 8 to 9:30 p m Musical program;
KGU, Honolulu, Hawaii, Waikiki Beach, Marion A. Mulroney; Honolulu Advertiser
KGW, Portland, Ore.; Oregonian Pub. Co.
KGY, Lacey, Wash.; St. Martin's College, (Rev. S. Ruth).
KHJ, Los Angeles, Calif.; Daily except Sunday: 12:30 p. m. to 1:15 p. m. news and concerts; 7 to 7:30 p. m. Children's Half Hour; 8 to 9:30 p. m. De Luxe program of music, news and educational features; Sunday: 10 to 11 a. m. Scripture reading, sermon, prayer and sacred musical program; Pacific time: Times-Mirror company.
KHQ, Seattle, Wash.; Louie Wasmer.
KJJ, Sunnyside, Calif.; The Radio Shop.
KJQ, Stockton, Calif.; C. O. Gould.
KJS, Los Angeles, Calif.; Bible Inst. of Los Angeles.
KLB, Pasadena, Calif.; J. J. Dunn & Co.
KFDH, Tucson, Ariz.; Univ. of Arizona.
KLS, Oakland, Calif.; Warner Bros.
KLX, Oakland, Calif.; Tribune Pub. Co.
KLZ, Denver, Colo.; Class B, 485, Reynolds Radio Co.
KMAZ, Macon, Ga., Mercer University.
KMC, Reedley, Calif.; Lindsay-Wetherill Co.
KMJ, Fresno, Calif. Max. 2576 Miles; Musical program, San Joaquin Light & Power Corp.
KMO, Tacoma, Wash., Love Electric Co.; Tacoma Times.
KNI, Eureka, Calif.; T. W. Smith.
KNJ, Roswell, New Mexico; 1000 miles; Every evening at 8; newe, weather reports, stock market, concerts and sermons; Roswell Public Service Co.
KNN, Los Angeles, Calif.; Bullocks.
KNT, Aberdeen, Wash.; North Coast Products Co.
KNV, Los Angeles, Calif.; Radio Supply Co.
KNX Los Angeles, Calif.; Electric Lighting Supply Co.
KDA, Denver, Colo.; Y. M. C. A.
KOB, State College, N. Mex.; time signals and weather reports 12 noon and 10: p m, mountain time: music and lectures Monday, Wednesday and Friday. 7:30 to 8:30 p m; New Merico College of Agriculture and Mechanical Arts.
KDE, Spokane, Wash.; Spokane Chronicle.
KDP, Detroit, Mich., Detroit Police Dept.
KDQ, Modesto, Calif., Modesto Evening News.
KPO, San Francisco, Calif., Hale Bros.
KQI, Berkeley, Calif., Univ. of California.
KQP, Hood River, Oregon; Apple City Radio Club.
KQV, Pittsburgh, Pa., Doubleday-Hill Elec. Co.
KQW, San Jose, Calif., Chas. D. Herrold.
KRE, Berkeley, Calif., Maxwell Electric Co.
DSC, San Jose, Calif., O. A. Hale & Co.
KSD, St. Louis, Mo.; 1700 miles; grain, livestock, cotton, New York stocks, poultry and butter market, metal market, official weather and news at 9:40, 10:40, 11:40, 12:40, 1:40, 2:40 and 4 p m; 8: p m 400 meters, musical and other features; Pulitzer Publishing Co.. St. Louis Post Dispatch.
KSL, San Francisco, Calif., The Emporium.
KSS, Long Beach, Calif., Prest & Dean Radio Research Lab.
KSU, Wenatchee, Wash.
KTW, Seattle, Wash., First Presbyterian Church.
KUO, San Francisco, Calif., Examiner Printing Co., San Fran. Examiner.
KUS, Los Angeles, Cal. 500 miles; setting up exercises daily, 7 to 7:30 a m and 12:00 noon to 12:30 p m; concert, 65 voices, 6 to 6:45 p m, Wednesdays and Fridays; City Dye Works.
KUY, Del Monte Calif., Coast Radio Co.
KWG, Stockton, Cal. Daily Market reports, music and newe 4 to 5 p m; Music, 2 to 3 p m, Sunday; Tuesdays and Fridays, music, 8 to 9 p m. Portable Wireless Telephone Co.
KWH, Los Angeles, Calif., Los Angeles Examiner.
KXD, Modesto, Calif., Herald Publishing Co.
KYQ, Honolulu, T. H., The Electric Shop.
KYW, Chicago, Ill.; Westinghouse Elec. & Mfg. Co. 345 meters.
KZM, Oakland, Calif., Western Radio Inst.; Preston D. Allen.
KZN, Salt Lake City, Utah, The Deseret News.
KZV, Wenatchee, Wash., Wenatchee Battery & Motor Co.
NDF, Anacostia, D. C., U. S. Navy Dept.
PWX, Havana, Cuba, Cuban Telephone Co.
WABD, Dayton, Ohio; 286 meters, 10 watts; Parker High School.
WAI, Dayton, Ohio, McCook Field, U. S. Army.
WAAB, New Orleans, La., Valdemar Jensen.
WAAC, New Orleans, La., Tulane Univ.
WAAD, Cincinnati, Ohio, Ohio Mechanics Inst.
WAAF, Chicago, Ill., Chicago Daily Drovers Journal.
WAAE, St. Louis, Mo., St. Louis Chamber of Commerce.
WAAH, St. Paul, Minn.; Commonwealth Electric Co.
WAAK, Milwaukee, Wis., Gimbel Bros.
WAAL, Minneapolis, Minn., Minnesota Tribune Co. & Anderson-Beamish Co.

(Continued on next page.)

Complete Corrected List of U. S. and Canadian Broadcasting Stations

WAAM, Newark, N. J, 200 miles; musical and code, every week day 11 to 11:55 a m, 3 to 4 p m; Wednesday evenings 8 to 9; I. R. Nelson Company.
WAAN, Columbia, Mo., Univ. of Missouri.
WAAP, Wichita, Kans., United Elec. Co.; Otto W. Taylor.
WAAQ, Greenwich, Conn., New England Motor Sales Co.
WAAS, Decatur, Ga., Georgia Radio Co.
WAAT, Jersey City, N. J., Jersey Review.
WAAW, Omaha, Neb., Omaha Grain Exchange.
WAAY, Youngstown, Ohio, Yohrling Rayner Music Co.
WAAZ, Emporia, Kans.; Daylite 100 miles; nite 500-1000 miles; each Tuesday and Thursday from 7 to 8 p m. Acknowledge all communications at 7:15 p m. The Hollister Miller Motor Co.
WABA, Lake Forest, Ill; 266 meters, 100 watts; Lake Forest College.
WABB, Harrisburg, Pa; 266 meters, 10 watts; Dr. John B. Lawrence.
WABC, Anderson, Ind; 299 meters, 10 watts, Fulwider-Grimes Battery Co.
WABD, Dayton, Ohio; 286 meters, 10 watts; Parker High School.
WABE, Washington, D. C; 283 meters, 50 watts; Y. M. C. A.
WABF, Mt. Vernon, Ill; 234 meters, 250 watts; Mt. Vernon Register-News Co.
WABG, Jacksonville, Fla; Arnold Edwards Piano Co. 248 meters; 10 watts.
WABI, Bangor, Me: Bangor Railway and Elect. Co.; 240 meters; 50 watts.
WABJ, South Bend, Ind; The Radio Laboratories; 240 meters; 50 watts.
WAJT, Marshall, Mo., Kelly-Vawter Jewelry Co.
WAJU, Yankton, S. D., Yankton College.
WABH, Sandusky, Ohio; 234 meters, 100 watts; Lake Shore Tire Co.
WBAA, W. Lafayette, Ind., Purdue University.
WBAD, Minneapolis, Minn., Sterling Elec. Co. & Journal Printing Co.
WBAE, Peoria, Ill., Bradley Polytechnic Inst.
WBAF, Moorestown, N. J., Fred M. Middleton.
WBAG, Bridgeport, Pa., Diamond State Fibre Co.
WBAM, New Orleans, La., I. B. Rennyson.
WBAN, Paterson, N. J., Wireless Phone Corp.
WBAO, Decatur, Ill.; 100 miles; occasional music; sermons; James Millikin Univ.
WBAP, Fort Worth, Tex.; 4000 miles; Markets and News; Feature concert Monday to Friday inclusive; 9:30 p m to 10:45 p m, Central Time; Quiet nights Saturday and Sunday. The Star-Telegram.
WBAQ, South Bend, Ind., Myron L. Harmon.
WBAU, Hamilton, Ohio, Republican Publishing Co.
WBAV, Columbus, Ohio, Ferner & Hopkins Co.
WBAW, Marietta, Ohio; Marietta College; 246 meters; 100 watts.
WBAX, Wilkes-Barre, Pa., John H. Stenger, Jr.
WBSA, Newark, O.; 240 meter, 20 watts; Newark Radio Lab.
WBSC, Sterling, Ill; 229 meter, 50 watts; Sterling Radio Equipment Co.
WBSD, Reading, Pa; Barbey Battery Service; 224 meters; 50 watts.
WBL, Anthony, Kans; T & H Radio Co; 261 meters; 100 watts.
WBS, Newark, N. J.; Radius 500 mi.; Musical and Educational, week days: 10:30 to 11 a. m.; 1:00 to 1:15 p. m.; 2:15 to 2:30 p. m.; 7:30 to 8:30 p. m.; Sundays: 9 to 10:30 a m; 1 to 3 p m; D. W. May, Inc.
WBT, Charlotte, N. C. 1200 miles; 11; a m weather report 485; 4:30 p m mechanical music; 8: p m Market Report; 8:30 Tuesday and Friday regular concert; 7:30 p m Sunday, Church Southern Radio Corp.
WBU, Cbicago, Ill., City of Chicago.
WBZ, Springfield, Mass., Westinghouse Elec. & Mfg. Co.
WCAB, Newburgh, N. Y., Newburgh Daily News; Newburgh News Printing & Pub. Co.
WCAC, Fort Smith, Ark., John Fink Jewelry Co.
WCAD, Canton, N. Y., St. Lawrence University.
WCAE, Pittsburgh, Pa.; 12:30 news and reports; 3:30 weatehr reports; 4:15 Closing Market reports; 7:30 Late news and lecture; 8:30 musical programs; Kaufmann Baer Co.
WCAG, New Orleans, La., Daily States Pub. Co.
WCAH, Columbus, O. Daily program 11:30 to 12:30; Every Tuesday evening at 7, musical program; C. A. Entrekin Electric Co.
WCAI, San Antonio, Texas, Southern Equipment Co.
WCAJ, Univ. Place, Neb., Nebraska Wesleyan University.
WCAK, Houston, Texas, Alfred P. Daniel.
WCAL, Northfield, Minn., St. Olaf College.
WCAM, Villanova, Pa., Villanova College.
WCAD, Baltimore, Md., Sanders & Stayman Co.
WCAR, San Antonio, Texas, Alamo Radio Elec. Co.
WCAS, Minneapolis, Minn., Wm. H. Dunwoody Industrial Inst.
WCAT, Rapid City, S. Dak., South Dakota School of Mines.
WCAU, Philadelphia, Pa.; 1000 miles; Daily 10:30 a. m.; 2:30 p. m.; 6:30 p m; regular concert 10 to 12 noon; Tuesdays, Fridays, Saturdays; Durham & Co., Inc.
WCAV, Little Rock, Ark., J. C. Dice Elec. Co.
WCAW, Omaha, Nebr., Woodmen of the World.
WCAX, Burlington, Vermont, University of Vermont.
WCAY, Milwaukee, Wis., Kesselman O'Driscoll Co.
WCBA, Allentown, Pa.; Chas. W. Haimbach; 280 meters; 5 watts.
WCBS, Greenville, O.; 240 meters, 100 watts; K. & K. Radio Supply Co.
WCE, Minneapolis, Minn., Findley Elec. Co.
WCK, St. Louis, Mo., Stix Baer & Fuller.
WCM, Austin, Texas, Univ. of Texas.
WCN, Worcester, Mass., Clark University.
WCX, Detroit, Mich., Detroit Free Press.
WDAD, Lindsburg, Kas.; Central Kansas Radio Supply.
WDAE, Tampa, Fla., Tampa Daily News.
WDAF, Kansas City, Mo; Kansas City Star; 411 meters; 500 watts. Regular concerts on Mon, Wed. and Fri. nights from 8 to 9:30. Concerts from 3:30 to 4:30 p m each afternoon except Sun. Baseball scores 3:25, 4:00, 4:30, 5:00, and 5:50 p. m. Marketgram and weather forecast 5:55 nightly, except Sun. Educational features and musical program 6 to 7 o'clock each night except Sunday. "Nighthawk" Frolic, Coon Sanders orchestra at the Hotel Muehlebach nightly except Sun. 11:45 p. m. to 1 a. m.
WDAG, Amarillo, Texas, K. Laurence Martin.
WDAG, Brownsville, Pa., Hartman-Riker Elec. & Mach.Co.
WDAH, El Paso, Tex.; Trinity Methodist Church.
WDAI, Syracuse, N. Y., Hughes Electrical Corp.
WDAJ, College Park, Ga., Atlanta & West Point R. R. Co.
WDAK, Hartford, Conn., Hartford Courant.
WDAL, Jacksonville, Fla., Florida Times Union.
WDAD, Dallas, Texas, Automotive Elec. Co.
WDAP, Chicago, Ill., markets, and concerts 360; Daily on all business days: 9:30 a. m. receipts and shipments; estimated car lots; local weather report; opening futures market in wheat, corn, oats, rye, barley, pork, lard and ribs. 10 a. m. Future quotations, live stock receipts and prices; 10:30 a. m. futures quotations; 11 and 11:30 a m. same; 12 noon, futures and cash grain prices; 12:30 and 1 p. m. futures quotations; 1:20 p. m. closing futures quotations and high and low for day. Cash grain prices. Gross bids for cash grain to arrive. 6 p. m. closing quotations; news items. On Saturdays closing prices at 12:05 p. m. instead of 1:20 p. m. Visible supply changes sent when posted. Regular concert scbedule 10 p. m. Tuesdays, Thursdays and Saturdays. Sunday evenings 9 p. m. and 10 p. m. Chicago Board of Trade official station.
WDAR, Philadelphia, Pa.; Lit Brothers.
WDAS, Worcester, Mass., Samuel A. Walte.
WDAU, New Bedford, Mass., Slocum & Kilburn.
WDAX, Centerville, Iowa, First Nat'l Bank.
WDAY, Fargo, N. D.; 244 meters. 50 watts; Fargo Radio Service Co.
WDM, Washington, D. C., Church of the Covenant.
WDT, New York, N. Y., Ship Owners Radio Service.
WDZ, Tuscola, Ill., James L. Bush.
WEAA, Flint, Mich., Fallain & Lathrop.
WEAB, Fort Dodge, Iowa, Standard Radio Equip. Co.
WEAD, Atwood, Kans., Northwest Kansas Radio Supply Co.
WEAE, Blacksburg, Va., Virginia Polytechnic Inst.
WEAF, New York City, N. Y., Western Electric Co.
WEAG, Edgewood, R. I., Nichols-Hineline-Bassett Lab.
WEAH, Wichita, Kans., Wichita Board of Trade and Lander Radio Co
WEAI, Ithaca, N. Y., Cornell University.
WEAJ, Vermilion, S. Dak., University of South Dakota.
WEAK, St. Joseph, Mo., Julius B. Abercrombie.
WEAM, North Plainfield, N. J., Burough of N. Plainfield.
WEAN, Providence, R. I., The Shepard Co.
WEAO, Columbus, Ohio, Ohio State University.
WEAP, Mobile, Ala., Mobile Radio Co.
WEAQ, Berlin, N. H., Y. M. C. A.
WEAR, Baltimore, Md., Balt. American & News Pub. Co.
WEAS, Washington, D. C., Tbe Hecht Co.
WEAU, Sioux City, Iowa, Davidson Bros. Co.
WEAV., Rushville, Nebr., Sheridan Elec. Service Co.
WEAX, Little Rock, Ark., T. J. M. Daly.
WEAY, Houston, Texas, Will Horwitz, Jr.
WEAZ, Waterloo, Iowa, Donald Redmond.
WES, St. Louis, Mo., The Benwood Co., Inc.
WEH, Tulsa, Okla., Midland Refining Co.
WEV, Houston, Texas, Hurlburt-Still Elec. Co.
WEW, St. Louis, Mo., St. Louis Univ.
WEW, St. Louis. Mo., Market and weather reports at 9 a. m., 10 a. m., and 2: p m; no other regular program; St. Louis University.
WEY, Wichita, Kansas, Cosradio Co.
WFAA, Dallas, Texas. A. H. Belo & Co.
WFAW, Miami, Fla., 1500 miles; 7:30 to 9 p. m. concerte ineluding Arthur Pryor's Band evenings and W. J. Bryan Sunday School, Sunday a m; Miami Daily Metropolis & Electrical Equipment Co.
WEAS, Syracuse, N. Y., C. F. Woese.
WFAC, Superior, Wis., Superior Radio Co.
WFAF, Poughkeepsie, N. Y., H. C. Spratley Radio Co.
WFAG, Waterford, N. Y., Radio Engineering Lab.
WFAH, Port Arthur, Texas, Elec. Supply Co.
WFAJ, Asheville, N. C., Hi-Grade Wireless Instrument Co.
WFAK, Brentwood, Mo., Domestic Electric Co.
WFAM, St. Cloud, Minn., Granite City Elec. Co. and Times Pub. Co.
WFAN, Hutchinson, Minn., Hutchinson Electric Service Co.
WFAQ, Cameron, Mo., Cameron Radio Co. and Mo. Wesleyan College.
WFAT, Sioux Falls, S. Dak.; also Argus-Leader.
WFAV, Lincoln, Nebr., Univ. of Nebr. Dept. of Elec. Engineering.
WFAZ, Charleston, S. Carolina, S. C. Radio Shop.
WFI, Philadelphia, Penn., also Strawbridge & Clothier.
WGAC, Brooklyn, N. Y., Orpheum Radio Stores Co.
WGAD, Ensenada, Porto Rico, Spanish-American School of Radio-telegraphy.
WGF, Des Moines, Iowa 300 miles; Musical and entertainment Tuesday and Friday 7:30 p m; Church Services Sunday at 5 p m or 7:45 p m as announced; Special programs as announced Register and Tribune.
WGAJ, Shenandoah, Iowa, W. H. Gass.
WGAL, Lancaster, Pa.; Lancaster Elect. Supply Co. 248 meters; 10 watts.
WGAM, Orangeburg, S. C., Orangeburg Radio Equip. Co.
WGAN, Pensacola, Fla., Cecil E. Lloyd.
WGAQ, Shreveport, La., Glenwood Radio Corp.
WGAR, Fort Smith, Ark., Southwest American.
WGAU, Wooster, Ohio; 226 meters, 20 watts; Marcus G. Limb.
WGAV, Savannah, Ga., B-H Radio Co.
WGAW, Altoona, Pa., Ernest C. Albright.
WGAX, Washington Court House, Ohio, Ohio Radio Elec. Co.
WGAY, Madison, Wis., North Western Radio Co.
WGAZ, South Bend, Ind., South Bend Tribune.
WGI, Medford Hillside, Mass., Am. Radio & Research Corp.
WGL, Philadelphia, Pa., Thos. F. J. Howlett.
WGM, Atlanta, Ga., Atlanta Constitution.
WGR, Buffalo, N. Y., Federal Tel. & Teleg. Co.
WGV, New Orleans, La., Interstate Elec. Co.
WGY, Schenectady, N. Y., General Elec. Co.
WHA, Madison, Wis., Univ. of Wis.
WHAA, Iowa City, Ia; 500 miles; 8:30 p m, Monday, instruction; Tuesday, concert; Wednesday, popular lecture; Friday, University News; public lectures and concerts irregularly; State University of Iowa.
WHAS, Galveston, Texas, Clark W. Thompson (Fellman's Dry Goods Co.)
WHAC, Waterloo, Iowa, Cole Bros. Elec. Co.
WHAD, Milwaukee, Wis.; Marquette Univ.
WHAE, Sioux City, Iowa, Automotive Elec. Service Co.
WHAG. Cincinnati, Ohio, Univ. of Cincinnati.
WHAH, Joplin, Mo; radius, 1384 mi.;Concerts, markets, weather, etc. Tuesday and Thursday evenings: 8 to 10; Daily except Sundays: 10 a. m. to 2 p. m.; Saturday night special: 11 to 12:30; Hafer Supply Co.
WHAI, Davenport, Iowa, Radio Equip. & Mfg. Co.
WHAJ, Bluefield, W. Va., Bluefield Daily Telegraph and E. K. Kitts.
WHAK, Clarksburg, W. Va., Roberts Hdwe. Co.
WHAL, Lansing, Mich., Lansing Capitol News.
WHAM, Rochester, N. Y. Daily—Weather reports 2:40 p. m.; Organ 2:45, 5:00, 6:45; Orchestra 3:00, 7:00; Bed-time stories, Sport results, Business reports and market reports, the latter on 485 meters, 7:15 p m; Sunday—Radio Chapel Service, 8:15 p m; University of Rochester.
WHAD, Savannah, Ga., Frederick A. Hill; every evening 8 to 9; Saturday nights, 12:30 1:30 a. m.
WHAP, Decatur, Ill., Dewey L. Otta.
WHAQ, Washington, D. C., Semmes Motor Co.
WHAS, Louisville, Ky., Courier Journal and Louisville Times Co.
WHAV, Wilmington, Del., Wilmington Elec. Spec. Co.
WHAW, Tampa, Fla. 100 miles; 12 to 1, 4 to 5 p m, music; Pierce Electric Co.
WHX, Des Moines, Iowa; 300 miles; 5:45 p m to 6:15 p m Daily; 8:00 p m to 10 p m Wednesday evenings; Central Standard time; Iowa Radio Corp.
WHAY, Huntington, Ind., Huntington Press.
WHAZ, Troy, N. Y., Rensselaer Polytechnic Inst.
WHB, Kansas City, Mo., Sweeney Auto & Tractor School.
WHD, Morgantown, W. Va., W. Va. University.
WHK, Cleveland, Ohio, Warren R. Cox.
WHN, Ridgewood, N. Y., Times Printing & Pub. Co.
WHU, Toledo, Ohio, Wm. B. Duck Co.
WIAB, Rockford, Ill., Joslyn Automobile Co.
WIAC, Galveston, Texas, Galveston Tribune.
WIAD, Ocean City, N. J., Ocean City Yacht Club.
WIAE, Vinton, Iowa, Mrs. Robt. E. Zimmerman.
WIAF, New Orleans, La; G. A. DeCortin, 10 Marlborough Gate; 234 meters, 10 watts.
WJAG, Norfolk, Nebr; 200 miles News and Markets 12:15, 3:30 and 5:30 p. m. The Huse Publishing Co. The Norfolk Daily News.
WIAH, Newton. Iowa, Continental Radio & Mfg. Co.
WIAI, Springfield, Mo., Heer Stores Co.
WIAJ, Neenah. Wis., Fox River Valley Radio Supply Co.
WIAK, Omaha, Nebr.; 7:45 a. m. Livestock receipts; 9:10 a. m. Livestock receipts and opening on hogs; 10:15 a m rainfall and temperature report and weather forecast for Nebraska and Iowa, Livestock market; 12 m cattle, hog and sheep market; 1:50 p m rainfall and temperature report and weather forecast for Nebraska and Iowa; market detail; 3:50 p m complete market reports and estimated receipts for next day; Daily Journal-Stockman.
WIAD, Milwaukee, Wis., School of Engineering.
WIAP, Springfield, Mass., Radio Development Corp.
WIAQ, Marion, Ind., Chronicle Pub. Co.
WIAR, Paducah, Ky., Musical 3:30 to 4 p. m. and 7 to 8 p. m. except Sundays. Paducab Evening Sun; Albert Bennett, operator.
WIAS, Burlington, Iowa, Hawk-Eye-Home Elec. Co.
WIAT, Tarkio, Mo., Leon T. Noel.
WIAU, Le Mars, Iowa, Am. Trust & Savings Bank.
WIAV, Binghamton, N. Y., N. Y. Radio Lab.
WIAW, Saginaw, Mich., Saginaw Radio & Elec. Co.
WIAY, Neenah, Wis; 224 meter, 100 watts; Fox River Valley Radio Supply Co.
WIK, McKeesport, Pa., K. & L. Elec. Shop.
WIL, Washington, D. C., Continental Elec. Supply Co.
WIP, Philadelphia, Pa., Gimbel Bros.
WIZ, Cincinnati, Ohio, Cino Radio Mfg. Co.
WJAS, Lincoln, Nebr., American Radio Co.
WJAD, Waco, Texas. Jackson's Radio Engrng. Lab.
WJAF, Muncie, Ind; 1800 miles; 7:30 to 8 Monday, Wednesday, Friday evening, music; 6:30 to 7 p m Saturday, music; 8:30 to 4 every afternoon, News; 10:30 to 12 M Sundays, Church service. Smith Electric-Muncie Press.

(Continued on next page.)

Complete Corrected List of U. S. and Canadian Broadcasting Stations

WJAJ, Dayton, Ohio 200 miles; Sunday 8:40, 9:15 Religious; Wednesday 9:15, 9:45 Entertainment; Friday 9:15 to 9:45 Entertainment. Y. M. C. A.
WJAK, Stockdale, Ohio White Radio Lab.
WJAM, Cedar Rapids, Iowa, Evening Gazette.
WJAN, Peoria, Ill; 280 meters, 100 watts; Daily except Sunday: 9 a. m. Peoria Livestock; 9:15 a. m. Special Weather Information; 11:30 a. m. weather, opening livestock and market quotations; 1:30 p. m. Closing livestock and markets, official weather information; talk to women by Phyills Ann; Monday and Thursday, government agriograms; 5:30 p. m. baseball reports during season; Tuesday, Thursday and Saturday, special concerts as announced at 9:15 p. m.; One musical number preceeds each broadcasting, Peoria Evening Star.
WJAP, Duluth, Minn. 1500 milea; Sunday 11 a m, 12:30 p m Church Service and organ recital; First Methodist Church, Rev. Chas. N. Pace, Pastor. Monday 8: p m to 9 p m, musical; Thursday 8 p m to 9 p m, musical; Kelley Duluth Co.
WJAQ, Topeka, Kans., Capper Publications.
WJAR, Providence, R. I., The Outlet Co., J. Samuels & Bros.
WJAS, Pittsburgh, Pa., Pittsburgh Radio Supply House.
WJAT, Marshall, Mo., Kelley-Yawter Jewelry Co.
WJAX, Cleveland, Ohio, Union Trust Co.
WJAZ, Chicago, Ill., Chicago Radio Lab.
WJD, Granville, Ohio; 229 meters, 50 watts; Richard Harris Howe.
WJH, Washington, D. C., White & Boyer Co.
WJX, New York, N. Y., De Forest Radio Telephone & Teleg. Co.
WJZ, New York, Radio Corp. of America; Aeolin Hall, 455 meters.
WKAA, Cedar Rapids, Ia.; Daily; weatther reports, crop reports, government reports; Mondays, Thursdaya and Saturdays: music; H. F. Paar.
WKAC, Lincoln, Nebr; Star Publishing Co; 275 meters; 100 watts.
WKAF, Wichita Falls, Texas, W. S. Radio Supply Co.
WKAH, West Palm Beach, Fla., Planet Radio Co.
WKAK, Okemah, Okla., Okfuskee County Newa.
WKAL, Orange, Texas, Gray & Gray.
WKAN, Montgomery, Ala., Alabama Radio Mfg. Co.
WKAP, Cranston, R. I., Dutee W. Flint.
WKAQ, San Juan, Porto Rico, Radio Corp. of Porto Rico.
WKAR, East Lansing, Mich., Mich. Agrl. College.
WKAS, Springfield, Mo., L. E. Lines Music Co.
WKAV, Laconia, N. H., Laconia Radio Club.
WKAW, Beloit, Wis; 242 meters, 10 watts; Turner Cycle Co.
WKAX, Bridgeport, Pa; W. A. McFarlane; 231 meters; 15 watts.
WKAY, Gainesville, Ga., Brenau College.
WKC, Baltimore, Md., Jos. M. Zamoiski Co.
WKN, Memphis, Tenn., Riechman-Crosby Co.
WKY, Oklahoma City, Okla., Oklahoma Radio Shop.
WLZ, Fairfield, Ohio, U. S. Army.
WLAC, Raleigh, N. C., N. C. State College.
WLAG, Minneapolis, Minn., Cutting & Walsh Radio Corp.
WLAH, Syracuse, N. Y., Samuel Woodworth.
WLAJ, Waco, Texas, Waco Elec. Supply Co.
WLAK, Bellows Falls, Vt., Vermont Farm Machine Co.
WLAL, Tulsa, Okla., Tulsa Radio Co.
WLAN, Houlton, Me., Putnam Hdwe. Co.
WLAP, Louisville, Ky., W. V. Jordan.
WLAQ, Kalamazoo, Mich., A. E. Schilling.
WLAS, Hutchinson, Kans., Hutchinson Grain Radio Co.
WLAT, Burlington, Iowa, Radio Specialty Co.
WLAV, Pensacola, Fla.; daily musical program, 8 to 9 p m; The Electric Shop.
WLAW, New York, N. Y., New York Police Dept.
WLAX, Greencastle, Ind., Greencastle Community Broadcasting Station.
WLAY, Fairbanks, Alaska, Northern Commercial Co.
WLAZ, Warren, Ohio, Hutton & Jones Elec. Co.
WLB, Minneapolis, Minn., Univ. of Minn.
WLK, Indianapolis, Ind., Hamilton Mfg. Co.
WLW, Cincinnati, Ohio, Crosley Mfg. Co.
WMA, Anderson, Ind., Arrow Radio Lab.
WMAB, Oklahoma City, Okla., Radio Supply Co.
WMAC, Cazenovia, N Y; J. Edw. Page; 261 meters; 50 watts.
WMAD, Rockport, Mo., Atchinson County Mail.
WMAE, Dartmouth, Mass., Round Hills Radio Corp.
WMAG, Liberal, Kana., Tucker Elec. Co.
WMAH, Lincoln, Nebr., General Supply Co.
WMAJ, Kansas City, Mo., Drovers Telegram.
WMAK, Lockport, N. Y., Norton Labs.
WMAL, Trenton, N. J, 100 milea; 7:30 to 9 p m, Mondays and Thursdays, musical programs, lectures etc; Trenton Hardware Co.
WMAM, Beaumont, Texaa, Beaumont Radio Equip. Co.
WMAN, Columbus, Ohio, First Baptiat Church.
WMAP, Easton, Pa., Utility Battery Service.
WMAQ, Fair Store Building, Chicago; 4:85 to 5 p m, daily; 7 to 7:30 p m, Monday, Wednesday, Friday and Saturday; 7 to 8 p m, Tuesday and Thursday; 9:15 to 10 p m daily; Chicago Daily News and Fair Department Store.
WMAR, Waterloo, Iowa, Waterloo Elec. Supply Co.
WMAT, Duluth, Minn., Paramount Radio Corp.
WMAV, Auburn, Ala., Polytechnio Inst.
WMAW, Wahpeton, N. D., Wahpeton Elec. Co.
WMAX, Ann Arbor, Mich., K. & K. Radio Supply Co.
WMAY, St. Louis, Mo., 600 miles; Religioua services Sunday, 11 a m and 8 p m; Tuesday at 7 p m; Kingshighway Presbyterian Church.
WMAZ, Macon, Ga., Mercer University.
WMH, Cincinnati, Ohio, Precison Equipment Co.
WMU, Washington, D. C., Doubleday-Hill Electric Co.
WNAB, Bowling Green, Ky., Park City Daily News.
WNAC, Boston, Mass.; Monday 4 to 5 p. m. (silent at night) Tuesday 4 to 5 p. m. and 7 to 8:30 p. m. Wednesday 4 to 5 p. m. 9:30 to 11 p. m. Thursday 4 to 5 and 7 to 8:30 p. m. Friday 4 to 5 and 8 to 9:30 p. m. Saturday 4 to 5 and 9:30 to 11 p. m. The Shopard Stores; J. J. Fanning, announcer; Samuel Curtis, operator.
WNAD, Norman, Okla., Okla. Radio Engineering Co.
WNAL, Omaha, Nebr., R. J. Rockwell.
WNAN, Syracuse, N. Y., Syracuse Radio Telephone Co.
WNAP, Springfield, Ohio, Wittenberg College.
WNAQ, Charleston, S. C., Charleston Radio Elec. Co.
WNAS, Austin, Texas, Radio Corp.
WNAT, Philadelphia, Pa. 1000 milea; Talks, Radio information, music, Chapel Service. Wednesday 7:30 p m; Saturday 7:80 p m; Sunday 2:30 and 4:30; Every day 12:15, 1 p m. Lonnig Bros. Co.
WNAV, Knoxville, Tenn., People's Tel. and Tel. Co.
WNAY, Baltimore, Md., Shipowners' Radio Service.
WNAW, Fortress Monroe, Va., Henry Kunzman.
WNAX, Yankton, S. Dakota; 244 meters, 100 watts; Dakota Radio Apparatus Company.
WNJ, Albany, N. Y., Shotton Radio Mfg. Co., Inc.
WNO, Jersey City, N. J., Wireless Telephone Co. of Hudson Co., N. J
WOAA, Ardmore, Okla.; radius 1,500 miles; Tuesdaya and Fridays: musical and educational programa; Dr. Walter Hardy; atation operated by G. H. Reitz.
WOAC, Lima, Ohio, Maus Radio Co.
WOAE, Fremont, Nebr., Medland College.
WOAF, Tyler, Texas, Tyler Commercial College.
WOAH, Charleston, S. C., Palmetto Radio Corp.
WOAI, San Antonio, Tex; 385 meters; Southern Equipment Company; Programs Daily; 10:30 a m Opening markets, U S weather forecast, crop reports, road reports, cotton reports, money market, livestock quotations and news bulletins, daily except Sun. 12:15 p m. Livestock quotations, produce markets, and news bulletins. 3 p m Closing markets, cotton reports, grain and market futures and news bulletins. 7 p m Complete baseball scores from American National and Texas leagues, final reports on markets, and news bulletins. Daily except Sun. 9:30 to 10:30 p m Concerts. Thurs. 7:30 to 8:30 p m Musical and Community Programs. Sunday 11:00 a m Church Services, 5:00 to 6:00 p m Concerts.
WOAJ, Parsons, Kans., Erving's Electrical Co.
WOAK, Frankfort, Ky., Collins Hardware Co.
WOAL, Webster Groves, Mo., Wm. E. Woods.
WOAN, Lawrenceburg, Tenn., Jamea D. Vaughan.
WOAQ, Omaha, Nebr. 100 miles; Woodmen of the World.
WOAQ, Portsmouth, Virginia; Portsmouth Kiwanis Club.
WOAR, Kenosha, Wis., Henry P. Lundskow.
WOAS, Middleton, Conn., Bailey's Radio Shop.
WOAT, Wilmington, Del., Boyd Martell Hamp.
WOAU, Evansville, Ind., Sowder Boiling Piano Co.
WOAV, Erie, Pa., Pa. Nat'l Guard.
WOAX, Trenton, N. J., Franklin J. Wolff.
WOAW, Omaha, Neb., 100 miles, Woodmen of the World.
WOAZ, Stanford, Texas, Penick Hughes Co.
WCBB, Greenville, O; 240 meters, 100 watts; K. & K. Radio Supply Co.
WOC, Davenport, Ia. time signals, 10:55 a. m.; weather 11 a. m.; 360 meters, 11:05 opening market quotations, agriograms; 12:00 noon, chimes concert; 2:00 p m, closing stocks and markets; 3:30 p m, educational talk; 5:45 p m chimes concert; 6:35, sandman's visit; 7:00 musical program; 8 p m, lecture; Sundays, religious and musical and religious features, 9 a m to 10 p m; Palmer's School of Chiropractic.
WOI, Ames, Ia., Iowa State College.
WOK, Pine Bluff, Ark., concerts Tuesday and Friday evoninga beginning at 9; Sundays, song service and sermens from churches at 11 a. m. and 7:30 p. m., Arkansas Light & Power Co.
WOO, Philadelphia, Pa., John Wanamaker.
WOQ, Kansas City, Mo., Western Radio Co.
WOR, Newark, N. J., L. Bamberger & Co.
WOS, Jefferson City, Mo.; first fifteen minutes of every hour from 8 a. m. to 2: p m; 5 p m, markets and music, 360 metera; Monday, Wednesday, Friday nights, 8 to 9:30 concerts; no Sunday program; Missouri State Marketing Bureau.
WOV, Omaha, Nebr., R. B. Howell.
WOU, Omaha, Nebr., Metropolitan Utilities.
WPA, Fort Worth, Texas, Fort Worth Record.
WPAA, Wahoo, Neh., Anderson & Webster Elec. Co.
WPAB, State College, Pa.
WPAC, Okmulgee, Okla., Donaldson Radio Co.
WPAD, Chicago, Ill., Wieboldt & Co.
WPAF, Council Bluffs, Iowa, Peterson'a Radio Co.
WPAG, Independence, Mo., Central Radio Co.
WPAH, Waupaca, Wis., Wisconsin Dept. of Markets.
WPAJ, New Haven, Conn., Doolittle Radio Corp.
WPAK, Fargo, N. D., North Dakota Agricultural College.
WPAL, Columbus, Ohio, Superior Radio & Tel. Equip. Co.
WPAM, Topeka, Kans., Awerhach & Guettel.
WPAP, Winchester, Ky., Theo. D. Phillips.
WPAQ, Frosthurg, Md., General Sales & Eng. Co.
WPAQ, Wilmington, Del., Radio Installation Co., Inc.
WPAR, Beloit, Kans., R. A. Ward.
WPAS, Amsterdam, N. Y., J. & M. Electric Co.
WPAT, El Paso, Texas, St. Patrick's Cathedral.
WPAU, Moorhead, Minn., Concordia College.
WPAY, Bangor, Me., Bangor Radio Laboratory.
WPAZ, Charleston, W. Va., Dr. John R. Koch.
WPE, Independence, Mo.
WPG, New Lebanon, Ohio 1500 miles; Program exclusive for the farmer; 12 to 12:15 p m News Flashes; 6 to 6:30 p m, News, Markets; 8 to 9:45 Monday and Wednesday; music and farm program. Nushawg Poultry Farm.
WPI, Clearfield, Pa., Electric Supply Co.
WPO, Memphis, Tenn., United Equip. Co.
WQAW, Washington, D. C.; Catholic University of Am.; 236 meters; 50 watts.
WSAC, Clemson College, S. C.; Clemson Agriculture College.
WQAA, Parkersburg, Pa. 1500 miles; 10:30 p m every evening. Horace A. Bealo, Jr.
WQAB, Springfield, Mo., Southwest Missouri State Teachers' College.
WQAC, Amarillo, Texas, E. B. Gish.
WQAD, Waterbury, Conn., Whitall Electric Co.
WQAE, Springfield, Vt., Moore Radio News Station.
WQAF, Sandusky, Ohio, Sandusky Register.
WQAH, Lexington, Ky., Brock-Anderson Elect. Eng Co.
WQAJ, Ann Arbor, Mich., Ann Arbor Times-News.
WQAK, Dubuque, Iowa, Appel-Higley Elec. Co.
WQAL, Mattoon, Ill., Cole County Tel. and Tel. Co.
WQAM, Miami, Fla., Electrical Equipment Co.
WQAO, New York, N. Y., Calvary Baptist Church.
WQAP, Lincoln, Nebr., Am. Radio Co.
WQAQ, Abilene, Texas, West Texas Radio Co.
WQAR, Muncie, Ind., Presa Publishing Co.
WQAS, Lowell, Mass.; Prince-Walter Company.
WQAT, Westhampton, Va.; Radio Equipment Corp.
WQAV, Greenville, S. C.; Huntington & Guerry, Inc.
WQAW, Scranton, Pa., Scranton Times.
WQAW, Washington, D C; Catholic University of America; 236 meters; 50 watts.
WQAX, Peoria, Ill.; Radio Equipment Co.
WQAY, Hastings, Nebr., Gaston Music & Furniture Co.
WQAZ, Greenshoro, North Carolina; Greensboro Daily Newa.
WRAA, Houston, Texas, Rice Institute.
WRAB, Savannah, Ga.; Savannah Board of Public Education.
WRAC, Mayville, N. D., State Normal School.
WRAD, Marion, Kansas, Taylor Radio Shop.
WRAF, Laporte, Ind; 224 meters, 10 watts; Radio Club, Inc.
WRAH, Providence, R. I.; Stanley N. Read.
WRAK, Escanaba, Mich.; Economy Light Co.
WRAL, St. Croix Falls, Wis.; Northern States Power Co.
WRAM, Carthage, Ill., Robert E. Compton & Carthage College.
WRAM, Galesburg, Ill., Lombard College.
WRAN, Waterloo, Iowa; 229 meters, 20 watts; Black Hawk Electrical Co.
WRAO, St. Louis, Mo., Radio Service Co.
WRAP, Winter Park, Fla.; Winter Park Electric Construction Co.
WRAR, David City, Nebr; J. C. Thomas; 226 meters; 20 watts.
WRAS, McLeansboro, Ill.; Radio Supply Co.
WRAU, Amarillo, Texas, Daily News.
WRAV, Yellow Springs, O., Antioch Colisge.
WRAY, Scranton, Pa.; radius 400 mi.; Sunday Chapel service; Wednesday; Selective Musical program, 8:15 to 10; Saturday: 8:15 to 11; Radio Sales Corp.
WRK, Hamilton, Ohio, Doron Bros. Elec. Co.
WRL, Schenectady, N. Y., Union College.
WRM, Urbana, Ill., Univ. of Ill.
WRP, Camden, N. J., Federal Inst. of Radio Telg.
WRR, Dallas, Texas, City of Dallas, Police and Fire Signal Dept.
WRW, Tarrytown, N Y; Tarrytown Radio Research Lab; 275 Metera; 50 watts.
WSAA, Marietta, O., B. S. Sprague Electric Co.
WSAB, Cape Girardeau, Mo., Southeast Mo. State College.
WSAC, Clemson College, S. C.; Clemson Agricultural College.
WSAH, Chicago, Ill.; A. G. Leonard, Jr.; 248 meters, 500 watts.
WSAJ, Grove City, Pa., Grove City College.
WSAL, Brookville, Ind.; Franklin Electric Co.
WSAP, New York City; Seventh Day Advsntist Church.
WSAT, Plainview, Texas, The Plainview Electric Co.
WSAV, Houston, Texas, C. W. Vick Radio Const'n Co.
WSB, Atlanta, Ga., Atlanta Journal.
WSL, Utica, N. Y., J. & M. Elec. Co.
WSY, Birmingham, Ala., Alabama Power Co.
WTAC, Johnstown, Pa., Penn. Traffic Co.
WTAS, Elgin, Ill; 275 meters, 500 watts; Chas. E. Erbstein.
WTAU, Tecumseh, Neb., Ruegy Battery & Elec. Co.
WTAW, College Station, Texas; Ag'c'ltle & Mech. College; 254 meters; 50 watts.
WTG, Manhattan, Texas, Kans. State Agri. College.
WTP, Bay City, Mich., Ra-Do Corp.
WVP, New York, N. Y. Signal Corps, U. S. Army.
WWAC, Waco, Tex; 800 miles; Weather forecasts 11 a m daily; musical concerts, daily, 1:30 p m and 2n Wednesday and Saturday evenings at 8; Sanger Bros.
WWAD, Philadelphia, Pa., Wright & Wright, Inc.
WWAX, Laredo, Texas, Worman Bros.
WWAY, Chicago, Ill.; Marigold Gardens.
WWB, Canton, Ohio, Daily Newa Printing Co.
WWI, Dearborn, Mich., Ford Motor Co.
WWJ, Detroit, Mich., Evening News.

(Continued on next page.)

Complete Corrected List of U. S. and Canadian Broadcasting Stations

WWL, New Orleans, La.; Musical and Educational; Loyola University; operated by Dept. of Physics.
WWX, Washington, D. C., Post Office Dept.
2XAI, Newark, N. J., Westinghouse Elec. & Mfg. Co.
2XI, New York City, A. T. & T. Co.
2XJ, Deal Beach, N. J., Amer. Tel. & Telg. Co.
3XW, Parkersburg, Pa., Horace A. Beale, Jr.
3YN, Washington, D. C., Nat'l Radio Inst.
9ARU, Louisville, Ky., Darrell A. Downard.

Canadian Stations

CFAC, Calgary, Alta., Can. Western Radio Co., Ltd.
CFCA, Toronto, Ont., Can. Toronto Star.
CFCB, Vancouver, B. C., Can. Marconi Co.
CFCE, Halifax, N. S., Can. Marconi Co.
CFCF, Montreal, P. Q., Can. Marconi Co.
CFCH, Iroquois Falls, Ont., Can. Abitibi Power & Paper Co.,, Ltd.
CFCI, Walkerville, Ont., Can. Motor Products Corp.
CFCN, Calgary, Alta., Can. W. W. Grant Radio, Ltd.
CFCX, London, Ont., Can. The London Advertiser.
CFPC, Fort Frances, Ont., Can. Internatolnal Radio Develop. Co.
CFTC, Toronto, Ont., Can. The Bell Telephone Co.
CFYC, Vancouver, B. C., Can. Victor Wentworth Odium.
CFZC, Montreal, Que., Can. Can. Westinghouse Co., Ltd.
CHBC, Calgary, Canada. W. W. Grant Radio, Ltd. (Morning Albertan.)
CHCA, Vancouver, B. C., Can. Radio Corp. of Vancouver, Ltd.
CHCB, Toronto, Can. Marconi Co.
CHCC, Edmonton, Alta., Can. Can. Westinghouse Co., Ltd.
CHCF, Winnipeg, Man., Can. Radio Corp. of Winnipeg, Ltd.
CHCQ, Calgary, Alta., Can. Western Radio Co., Ltd.
CHCS, London, Ont., Can. London Radio Shoppe.
CHCX, Montreal, Que., Can. B. L. Silver.
CHCZ, Toronto, Ont., Can. Globe Printing Co.
CHQC, Vancouver, B. C., Can. Can. Westinghouse Co., Ltd.
CHVC, Toronto, Canada. Metropolitan Motors Co.
CHXC, Ottawa, Ont., Can. J. R. Booth, Jr.
CHYC, Montreal, Que., Can. Northern Elec. Co.
CJBC, Montreal, Que., Can. Dupuis-Freres.
CJCA, Edmonton, Alta., Can. Edmonton Journal, Ltd.
CJCB, Nelson, B. C., Can. James Gordon Bennett.
CJCD, Toronto, Can., T. Eaton, Co.
CJCE, Vancouver, B. C., Can. Vancouver Sun.
CJCF, Kitchener, Ont., Can. News Record, Limited.
CJGG, Winnipeg, Canada. Manitoba Free Press.
CJCH, Toronto, Ont., Can. United Farmers of Ontario.
CJCI, St. John, N. B., Can. McLean, Holt & Co., Ltd.
CJCN, Toronto, Ont., Can. Simons, Agnew & Co.
CJCS, Halifax, N. S., Can. Eastern Telephone & Telegraph Co.
CJCY, Calgary, Alta., Can Edmund Taylor.
CJGC, London, Ont., Can. London Free Press.
CJNC, Winnipeg, Man., Can. Tribune Newspaper Co.
CJSC, Toronto, Ont., Can. Evening Telegram.
CKAC, Montreal, Can. La Presse.
CKCB, Winnipeg, Man. Can. T. Eaton Co., Ltd.
CKCD, Vancouver, B. C., Can. Vancouver Daily Province.
CKCE, Toronto,Ont., Can. Can. Ind. Telephone Co.
CKCK, Regina, Sask., Can. Leader Pub. Co.
CKCR, St. John, N. B., Can. Jones Elec. Radio Co., Ltd.
CKCS, Montreal, Que., Can. The Bell Telephone Co.
CKCZ, Toronto, Ont., Can. Westinghouse Co., Ltd.
CKKC, Toronto, Ont., Can. Radio Equipment & Supply Co., Ltd.
CKOC, Hamilton, Ont., Can Wentworth Radio Supply Co., Ltd.
CKQC, London, Ont., Can. Radio Supply Co.
CKZC, Winnipeg, Man., Can. Salton Radio Eng. Co.

WWV Transmits More Standard Waves

In an effort to permit radio operators and fans to check their wave meters and instruments on standard waves, the Bureau of Standards will transmit standard wave lengths commencing at 10:55 p. m., each night, on July 17, August 15, September 13 and 28 and on October 7.

On the last date, WWV will enable amateurs to calibrate their receiving and transmitting sets, since the band covered will be from 222 to 150 meters, the signals being sent between 1:50 a. m. and 3:41 a. m.

The schedule follows (Keep it for future reference):

Date	Frequency K-c	Wave lgth, met.
June 11	400 to 1000	750 to 300
July 17	425 to 1500	705 to 200
Aug. 15	425 to 1500	705 to 200
Sept. 13	425 to 1500	705 to 200
Sept. 28	500 to 1700	600 to 176
Oct. 7	1350 to 2000	222 to 150 (Amateurs)

In continuation of the established practice, the Bureau will transmit the call signals "WWV" both in radio telegraph and telephone, each wave length occupying about nine minutes of time.

Now It Is Zion

WCBD, broadcasting station of Zion City, Ill., is in operation with a wave length of 245 meters. The station cost $30,000. Wilbur Glenn Voliva, successor of the well-remembered and peppery John Alexander Dowie, will use the station to broadcast his sermons. There also will be songs by the angel choir of five hundred voices and music by the Zion band and the orchestra. Mr. Voliva believes the earth is flat but he, at least, is a few steps ahead of Chris Columbus, so far as radio is concerned. Columbus knew something about navigation, but nary a thing about a loose coupler.

Untaxed Music

KYW has made considerable of a hit with the new jazz melody, "St. Louis Tickle." This number has also been broadcast from several of the member stations of the National Broadcasters' League, 500 North Dearborn street, Chicago. The National Broadcasters' League has received many appreciative letters from members in acknowledgment of the receipt of musical numbers which have been furnished by the league through Harold Rossiter, independent music publisher and Chairman of the Program Committee of the League. The League has been doing effective work in making it unnecessary for broadcasters to depend upon music controlled by the American Society of Authors Composers and Publishers. The American Society insists on a tax for the use of copyrighted music by broadcasters and the broadcasters simply refused to assume the additional expense.

Radio Helps Sermons

Radio broadcasting of the sermons and songs of the Sunday evening club programs, broadcast by KYW from the Orchestra hall, Chicago, has resulted in an increased attendance at these religious services, according to John W. O'Leary, Secretary of the club. Furthermore, contributions of money from distant radio listeners, who have heard the services, have assisted in defraying expenses of the Sunday evening programs.

Long Distance

A wireless message from the Naval station at Cavite, P. I., addressed to San Francisco, for relay to Washington, was picked up in the Washington Radio Central recently and copied before the San Francisco operator indicated its receipt. Needless to say, it was not relayed to Washington. This message was copied without error over 11,500 miles of sea and land.

Audience of 5,000,000

A new record in radio has been added with the report of the complete success of having 5,000,000 persons—the largest number ever addressed—listening recently to the program at Carnegie Hall aranged by the National Electric Light, Association.

Stations KYW, Chicago; WEAF, New York; KDKA, Pittsburgh, and WGY, Schenectady, were connected out of the hall by telephone wires, duplicate wires being run from the hall to each of the outlying stations.

Martin J. Insull, of Chicago, presided at the meeting, at which Julius H. Barnes, President of the Chamber of Commerce of the United States, spoke.

Boost for League

On with the dance! So say radio fans who cut in on the program sent out by KYW, Westinghouse broadcasting station.

The station is now sending out dance music played by Cope Harvey's orchestra and it is the first time the big station has linked up with an orchestra leader since the American Society of Composers, Authors and Publishers placed a ban on their copyrighted numbers being sent over the radio.

The dance selections are from the independent publishers and have been obtained through the National Broadcasters' League. Fifteen selections were released this week to broadcasters in twenty states and ten more will be released next week.—[Chicago Herald and Examiner.

Exports Increase

During the first three months of 1923 the value of exports of American made radio and wireless apparatus exceeded $500,000. An increase of over $30,000 a month, since the first of the year, is shown by figures just issued by the department of commerce.

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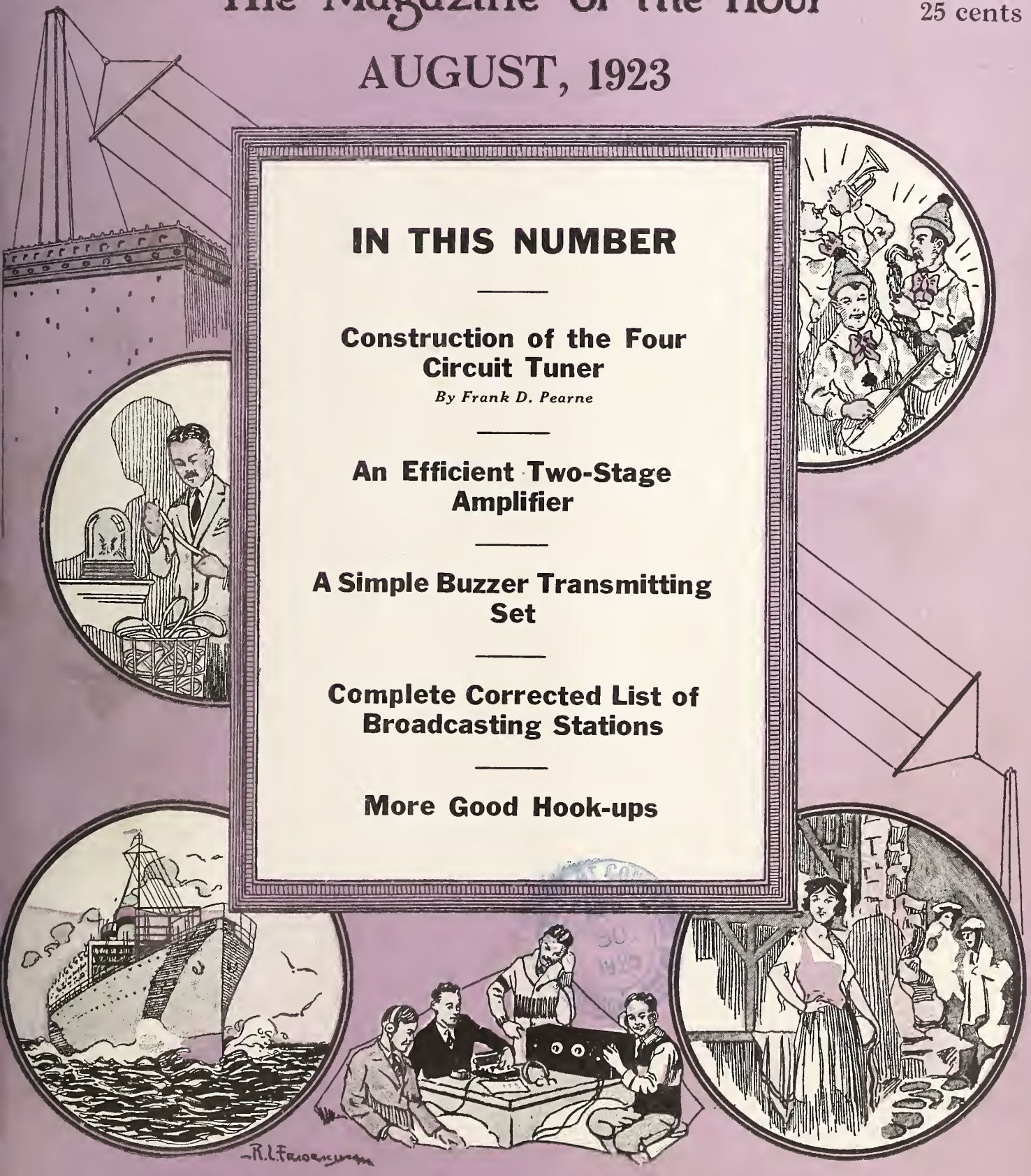
Price 25 cents

AUGUST, 1923



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By Frank D. Pearne

An Efficient Two-Stage Amplifier

A Simple Buzzer Transmitting Set

Complete Corrected List of Broadcasting Stations

More Good Hook-ups

OFFICIAL NEWS MEDIUM FOR NATIONAL BROADCASTERS' LEAGUE

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How to amplify it.
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RADIO AGE

The Magazine of the Hour

Volume 2 *AUGUST, 1923* *Number 7*

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For September

THERE will be an article in the September issue of this magazine that will be of intense interest and of tremendous help to all the radio receiving set operators. We suggest that you get the September issue and look out for it. It will be duly announced on the front cover and you will not miss it. We would tell more about this article for broadcast listeners but we are afraid our wide-awake contemporaries might read this and then set out to get together an inadequate and hastily prepared article on the subject in order to avoid being scooped.

By the way, the number of fans who are becoming acquainted with the superior quality of our technical articles would surprise you. We have been fortunate enough to gain a reputation for publishing well written instructions on how to make receivers and how to operate them.

Many letters come in, even during these dog days, telling us that our illustrations are the clearest and our technical discussions the most timely.

You have not forgotten that the technical editor of Radio Age is Mr. Frank D. Pearne, for twelve years the chief instructor in electricity at Lane Technical High School, Chicago. Mr. Pearne is more than an expert—he is an institution. You should see the letters he receives daily from radio fans. They have confidence in him because he knows what he is talking and writing about and he knows how to write and talk about what he knows.

Among recent subscriptions sent in we have had several for two years and a lesser number for three years. Now when a fan pays for his favorite book on radio that far in advance it shows confidence and conviction. Doesn't it?

If you want unbiased evidence on how our technical writers have been hitting the ball read the page of boosts from readers in this number. We thank you.

—The Editor.

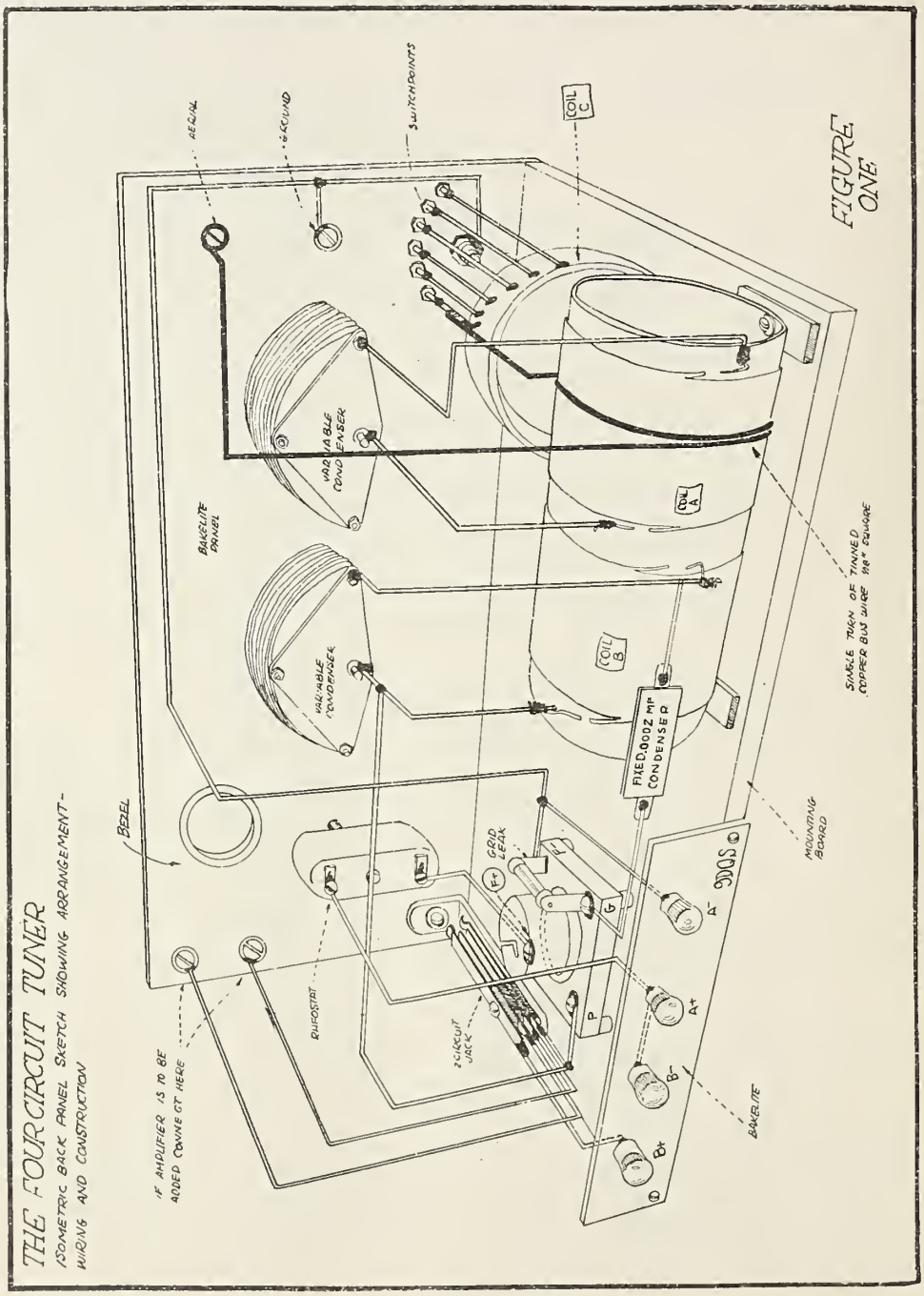


FIGURE ONE
THE FOUR CIRCUIT TUNER
ISOMETRIC BACK PANEL SKETCH SHOWING ARRANGEMENT-WIRING AND CONSTRUCTION
AERIAL
GROUND
SWITCH POINTS
COIL C
COIL A
COIL B
VARIABLE CONDENSER
VARIABLE CONDENSER
BAKELITE PANEL
BEZEL
FIXED .0002 MF CONDENSER
GRID LEAK
RHEOSTAT
2 CIRCUIT JACK
IF AMPLIFIER IS TO BE ADDED CONNECT AT HERE
STABLE TURN OF TINNED COPPER BUS WIRE 1/16" SQUARE
MOUNTING BOARD
BAKELITE
A-
A+
B-
B+
P
G
F+

RADIO AGE
"The Magazine of the Hour"
M. B. SMITH PUBLISHER
PUBLISHED MONTHLY
FREDERICK SMITH EDITOR

Construction of the Four Circuit Tuner

By FRANK D. PEARNE

ONE OF the unique contributions to the science of radio, is the four-circuit tuner, invented and developed by Laurence M. Cockaday of Station 2XK. The arrangement of this circuit is peculiar, indeed, and the advantages claimed over other circuits are first, wonderful selectivity; second, ease of operation and third, the fact that it is extremely sensitive. CW messages have been received over a distance of 3,200 miles and broadcast reception has reached the distance of 2,400 miles. This range is probably due to the manner in which the feeble impulses received upon the aerial are stepped up in the receiving transformer.

A ratio of sixty-five to one is used at this point in the circuit, which gives a very high voltage on the grid, even though that produced in the aerial may be extremely low. This high ratio is obtained by placing a single turn of square copper bus wire—in the aerial, or primary circuit—in inductive relation with a secondary coil consisting of sixty-five turns.

By referring to the drawing, Fig. 2, it will be seen that the aerial inductance consists of two coils, one of which is the single turn previously mentioned, connected in inductive relation to the coils "A" and "B," and the other, a bank-wound tuning coil used for tuning the antenna circuit. This latter coil must be placed at right angles to the others, to prevent inductive coupling.

This arrangement of the mounting is plainly shown in Figure 1. The secondary coil, "A," is connected in series with a condenser "C1" of approximately .00035 M. F. and forms a separate oscillating circuit, which is inductively connected to the oscillating circuit formed by the combination of coil "B" and the .00035 M. F. variable condenser. This coil "B" is used as a stabilizer.

The rather unusual arrangement of this circuit as shown in Figure 2 may strike terror in the heart of the timid amateur, but if he will carefully study each detail, he will find that it is really quite simple, and that the first impression received is only due to its radical departure from the other conventional circuits. Reports received by the writer from those who have constructed the set are flattering, indeed, principally due to the absence of troubles such as body capacity, interference, and the ease with which distant stations may be brought in.

Details of Construction

The first step in the construction of the coils is to procure a tube of some good insulating material, bakelite if possible, but if this cannot be readily obtained a dry pasteboard tube will do. This should be 5 5/16 inches in length and 3¼ or 3½ inches in diameter. Drill two small holes just large enough to take a number 18 wire through them, about ½ inch apart, at a point 5/16 of an inch from the end of the tube. Straight along the axis of the tube drill two more holes the same distance apart, at a point 1½ inches from the first holes. Next drill two more holes beside the last two, about ⅛ of an inch from them. At a distance of 3 inches from these holes, drill two more. These last two will come close to the other end of the tube. These holes are to be used for anchoring the ends of the coils, as shown on "A" and "B," Figure 1. Coil "B" is wound first.

This is wound between the holes which are 3 inches apart. Use No. 18 SCC. magnet wire, anchoring the starting end by threading the wire through the holes on the end of the tube. Leave an end of about 8 inches for connecting later and wind 65 turns, which will bring the end of the coil right up to the holes to be used for anchoring the ends. Cut the wire, leaving 8 inches for connecting and thread the wire through the holes to anchor the end. Now start the coil "A" in the next two holes, with the same

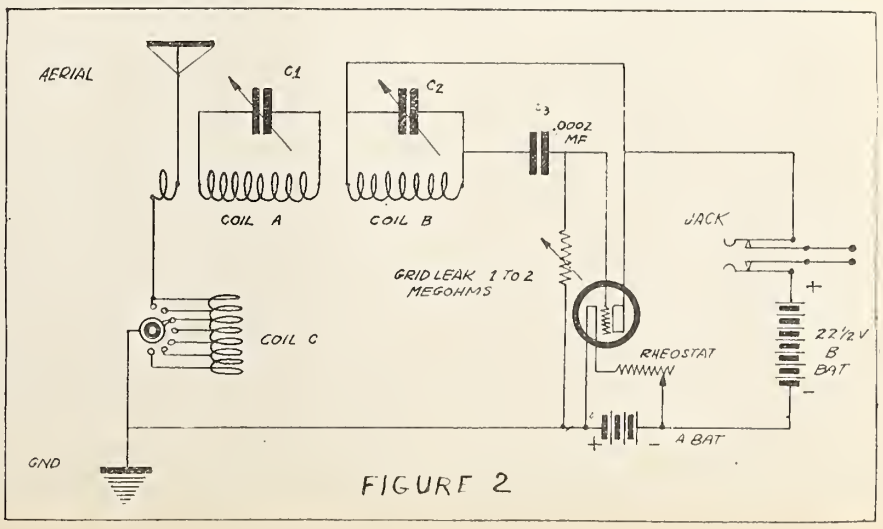


FIGURE 2

size of wire—don't forget to leave an 8 inch end—and wind 34 turns which will bring the winding up to the last two holes.

This completes the winding of the tube, with the exception of the single turn which is to be wound around coil "A" later. After making sure that these two coils are wound in the same direction, give it a good coat of shellac varnish and allow it to dry.

The next step is the winding of the bank-wound coil used for tuning the aerial, or primary circuit. This is wound on a piece of tubing of the same diameter used for the other coils. Cut off a piece of the tube, 1⅜ inches in length and drill 2 holes at each end (as close as possible without breaking through the edge) to hold the ends of the coil. This coil is to be double bank-wound, and is really the only hard part of the set to construct, but after one once gets the idea of the winding, it will not be difficult. To do this right, it is a good plan to first give the tube a thin coat of shellac varnish and do the winding before it becomes very dry. Start the winding at one end in the usual way and wind two complete turns. The third turn, instead of being placed next to the second, is wound on top of these two. This will lie in the small groove, formed by the natural curvature of the wires.

Upon the completion of these three turns, the wire is brought down to the tube again and one more turn is wound on the tube. This should be placed next to the second turn. The next turn is placed on top of turns 2 and 4, etc., until 43 turns have been put in place in this manner. This should be wound with the same size and kind of wire as that used in coils "A" and "B."

This would not be so hard, were it not for the fact that taps must be taken off every so often. These taps must be brought out at the 7th, 13th, 21st, and the 31st turns, the final end of the wire acting as the tap for the 43d turn. These taps may be made by making a loop of the wire at the point where they are to be taken off and twisting it up tight against the coil. Figure 1 shows the position and method of mounting the coils in the set.

This may be varied to suit the taste of the builder, but in any event, the coil "C" must be mounted at right angles to coils "A" and "B" as shown.

After the coils are mounted and the taps from coil "C" are connected to the switch contacts, as shown in Figure 1, the single turn of tinned copper, square bus wire is put in place and connected to the aerial binding post, and the last contact on the aerial switch. It must be remembered that the single turn of bus wire is placed around the coil having 34 turns, not the one having 65 turns. The switch lever is connected to the ground, grid leak and the positive side of the filament battery. The grid condenser, "C3" should be of the fixed mica insulated type, and the grid leak may be either a tubular leak having from one to two megohms, or of the variable type having the same resistance. The two variable condensers, "C1" and "C2," should have a capacity of approximately .00035 M. F. and are mounted on the panel and wired, as shown in Figure 1. The balance of the circuit is made of standard apparatus, which may be obtained at any radio supply store. It will be noted that Figure 1 shows the tuner only, while Figure 2 shows two connections from the inside springs of the jacks which may be connected to an amplifying unit if so desired.

If an amplifier is to be added to the tuner, the standard amplifying circuit may be employed. For the detector, UV-200 tube is recommended and if the amplifier is used, best results will be obtained with the UV-201-A tubes. The rheostat used on the detector tube should be of the vernier type, as this will be found to be one of the most sensitive adjustments in the set.

Wiring the Set

It is always a good plan to use large wire in connecting up the set. No. 14 tinned copper serves very well for this purpose, the tinned surface making it much easier to solder the joints. It is also suggested that the grid condenser be placed on the grid terminal of the socket and soldered to it. By all means solder all connections, even those where the wires connect to the binding posts, as one can never be too sure about these connections being good. The wiring may be covered with insulating tubing if desired, but this is unnecessary if No. 14 wire is used. It is, however, a good plan to use sleeving on the taps connecting the aerial switch contacts, as these wires sometimes come close together and the tubing will prevent short-circuiting. The wiring should be done in a neat manner, with all connections as short as possible.

Where Trouble Might Occur

If when the set is all wired up, it refuses to function as it should, reverse the connections of coil "B" as it is sometimes very easy to get this part of the set connected up wrong. This however, is about the only serious trouble which might occur, but if the directions are carefully followed out the results will surprise the most skeptical.

Useful Pointers

A good way to make sure that all your connections are correct is to use a colored pencil when you are connecting your set and as you connect each wire on the set, mark out the corresponding symbol and line on the diagram you are working from. When you have finished, there will be no danger of your having left out any connections. It is a good plan to start out connecting the filament circuits of the set you are making first, and testing it by lighting the bulbs in the ordinary. If they are connected correctly, you may then proceed with the rest of the circuit.

Always hang up your phones after you are through using them, as the long cord dropping down to the floor may be stepped on and the phones dashed to the floor. When one considers how sensitive a set of headphones are, being able to detect currents of .00016 of an ampere, you will readily realize that they should be treated with care and consideration. A bad bump or drop will sometimes cause the headset to lose its magnetism or bend the diaphram, which will result in inefficiency, which will later be laid to the set. Take care of your headset.

Did you ever know that crystals could be washed, and their sensitivity improved? Well, they can. Wash them in lukewarm water, with a stiff brush, holding them in a piece of clean silver-paper. Crystals should not be handled to excess with the bare fingers, as the fingers always have oil and grease on them no matter how clean you may wash them. If this gets on the crystal it doesn't work so well.

Short Aerials

B. O. Borgeson, of Chicago, says he hears all local stations using a ten-foot piece of wire strung from the ceiling down to his set, consisting of a short-wave three-circuit regenerative set using two stages of radio frequency, detector, and two stages of audio frequency. He uses Atwater-Kent apparatus. It makes an ideal way of receiving local concerts and programs through static and interference.

The Editor of this magazine uses about twenty feet of bell wire, strung around the picture moulding of his living room, and has to his credit a 1,000 mile range, using a Reinartz circuit with a two-stage audio frequency amplifier.

Another of our readers, Bosworth Lape, when writing in for more information on circuits, using a Reinartz hookup, tells of a one-tube reception of Omaha, Nebr., through static. Mr. Lape lives in Mansfield, Ohio, and it isn't every night that a fellow can get such good distance during the summer.

How To Construct An Efficient Two Stage Amplifier

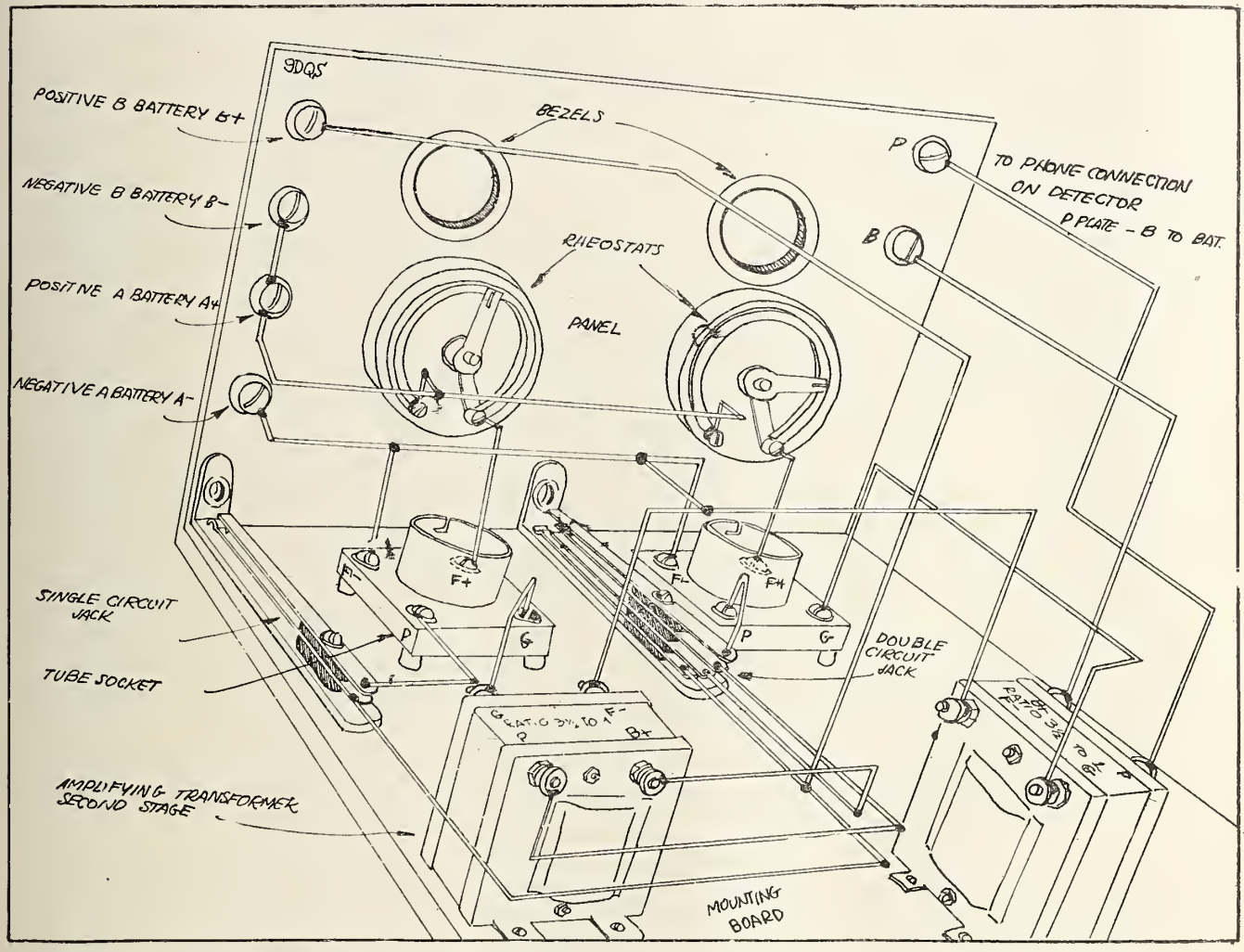


Figure 1. This shows the panel arrangement and wiring of the two stage audio frequency amplifier. Note especially the connections on the jacks.

By FELIX ANDERSON, Radio 9DQS

A glance at the title of this article will probably convey the impression that this manuscript must have been found along with some antiquated radio literature, considering the recent trend of radio experimentation. Read the article. It is up-to-date.—The Editor.

WHEN WE stop to summarize the present developments with radio frequency, reflex and nuetrodyne systems, together with the discovery of new basic theories, it leaves us aghast at the tremendous pace of radio progress.

In the wake of this progress, various circuits and systems are falling into disuse and are seldom heard of or used. Few indeed are surviving ideas.

Let us not forget the fact that among these survivors is the original audio frequency amplifier idea, a standard idea, which everybody takes for granted.

True enough—you say, but almost every BCL knows how to construct an audio frequency amplifier—what we are just now interested in is radio frequency amplification or reflex or nuetrodyne systems.

"I have a one tube set," writes an enthusiast, "with which I am getting unusual distance, but the signal is so weak that at the best it makes difficult the reception of these long distance stations. How can I make them louder?"

The answer is simple—*audio frequency amplification.* You can use any good system, radio frequency, nuetrodyne or even reflex to advantage and get range, but where volume is necessary we make use of our old standby, AF amplification.

The writer has taken particular note of the present construction ideas and articles, and finds that nearly all are devoted to one or more of the new radical ideas now being pushed. We know there are many BCL's who wish to get volume, but don't know how and a concise, clear and detailed description of how it is accomplished will not be amiss.

The most efficient and most widely used system is the conventional two-stage transformer coupled circuit, shown in figure 2. In the characteristics of its construction, we wish to emphasize the following:

1. Flexibility—enabling the builder to connect the amplifier to his present detector unit.
2. Compactness.
3. Efficient and noiseless operation giving maximum volume, with least distortion.
4. Minimum Cost.

The following apparata will be necessary for the construction of this amplifying unit:

1 panel of bakelite or formica 9 by 7 by 3-16 inches.
2 audio frequency transformers 3 1-2 to 1 ratio.
2 tube sockets.
2 rheostats.
1 double circuit jack.
1 single circuit jack.
6 binding posts.
2 U V 201 A amplifying tubes.
2 45 volt B batteries.
15 feet of tinned copper bus bar wire.
1 telephone plug.
1 mounting board.
2 panel bezels.
Cabinet and filament battery.

After the above apparatus has been purchased, the first thing to do is to lay out and drill the panel. It is not necessary to use a 9 by 7 inch panel; if the builder desires to make the amplifier in harmony with the set he already has probably the best way would be to make it in proportion to the cabinet of the detector set to which the amplifier is to be connected. We will let this rest with the judgment of the builder.

No template instructions are given as the constructor will no doubt wish to use apparatus of his or her own selection, and consequently different holes must be drilled to suit the particular apparatus one chooses.

The mounting shown in figure 1 is the arrangement the writer has found practical and harmonious.

THE TRANSFORMER. The selection of the amplifying transformer is very important considering the many makes now in use. Heretofore, the general belief was that a very high ratio transformer was necessary on the first stage of the amplifier, but test and experiments have demonstrated that at a slight sacrifice in volume by the use of a lower ratio transformer, the gain in tone and clarity is increased to a remarkable degree. In the set shown two transformers of three and one-half to one ratio, made by the National Transformer Manufacturing Company of Chicago were used with very good results.

These transformers are marked P and B plus for the primary connections, P indicating the plate of the tube and B plus indicating the positive B battery. Secondary connections are G and F minus representing the connections to the grid of the tube and the negative filament respectively.

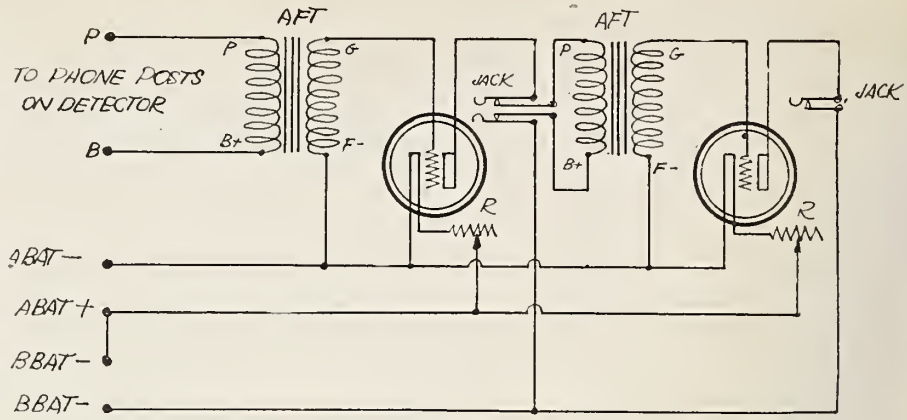


Figure 2. Circuit diagram of connections for the two stage audio frequency amplifier, showing the binding post connections.

The F minus on the transformer *must* be connected to the filament negative as a negative charge is necessary on the grid when the tube is used as an amplifier.

THE BINDER POSTS shown at the upper right hand corner of the panel are connected to the output of the detector or the phone posts on this tube. These connections will have to be traced out in the detector to determine which is connected to the plate of the detector tube and which is connected to the positive B battery.

JACKS are shown in the illustrations with their connections. Four springs are shown on the first stage, and only two on the second. The use of a double circuit jack is not necessary on the second stage unless a third stage is contemplated, and which can be easily added without danger of howling if a low ratio transformer is used. If a third stage is to be added, a double circuit jack is used disregarding the two center springs entirely. The jack makes contact with a plug which when inserted into the jack spreads the two outer springs apart. When no plug is inserted these outer springs make contact with the inner ones which are connected to the primary of the transformer. When the jack is inserted the separation of the top and center springs opens the circuit, and the current travels through the phones.

THE RHEOSTATS should be of the correct design for the U V 201 A bulb, and should have a higher resistance than for the ordinary six-volt tube. The multistat, made by the Crosley Company, is very good for this purpose.

BEZELS as shown are used to observe the tubes and their filament brilliancy when burning. They are purely ornamental, and a series of small holes drilled in a diamond formation will serve as well.

The transformer should be placed as far apart in the arrangement as possible, and should be mounted as shown with their windings running opposite to each other to counteract any undesirable inductive relation to each other.

By using a potential of from 65 to 150 volts on the plates of the tubes sufficient volume may be had to connect the set up to the phonograph or a horn using the arrangement shown in RADIO AGE for July. If a Magnavox or similar power amplifier is used, the volume will be sufficient to fill a good sized hall.

If you want a good clear loud signal use AUDIO FREQUENCY.

Records on Cruiser

With the Model TF tube transmitter installed on the United States cruiser, "Omaha," reliable communication was obtained up to 1,200 miles by day on C. W., and up to 1,600 miles night by ICW and voice. With the 20 killowatt arc daylight ranges of 1,800 miles were obtained while working vessels of the United States fleet, and 2,000 miles while working shore stations.

During a single day on May 25, 1923, the Navy Department communication office handled a total of 858 messages. This was the high mark in two years' service.

Cape May Quits

The Naval Radio Traffic Station at Cape May, N. J., has been closed and abandoned. The transmitter at that station was removed to Radio Compass station at Henlopen, the latter station becoming the Compass Control station for the group composed of Cape May, Cape Henlopen and Bethany Beach. Traffic formerly handled by the Cape May station will be handled by the radio station at Philadelphia.

A Simple Buzzer Transmitting Set

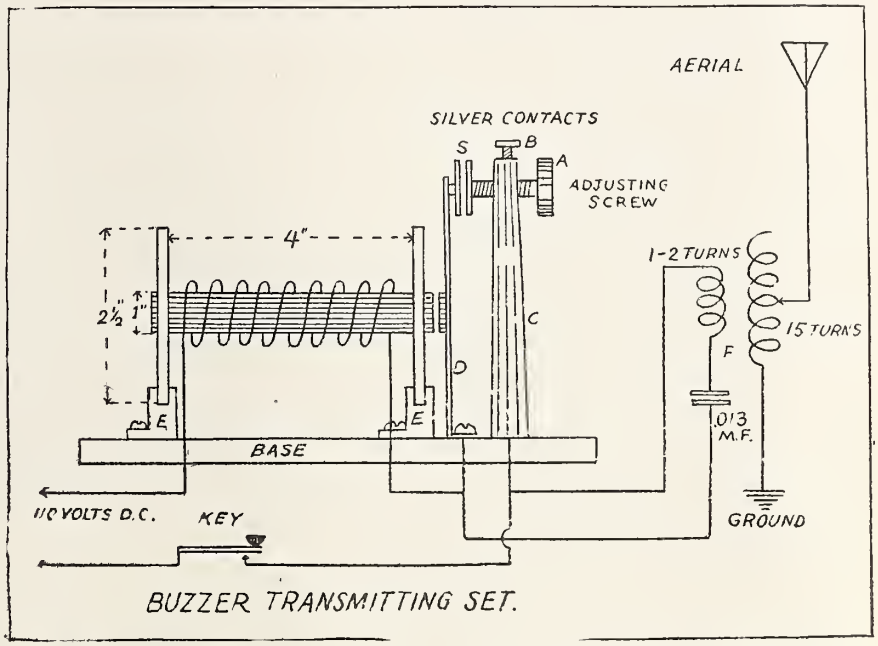
By FRANK D. PEARNE

A VERY simple buzzer transmitting set, by means of which signals may be transmitted for distances of twenty-five to one hundred miles can be constructed by the amateur at a very small cost. However this is interesting only to those who have a government license, or to those who expect to have one, as it cannot be used without first taking the examination given by the government.

The principal part of this set is the coil which operates the vibrator. This is made by cutting out two fiber discs 2½ inches in diameter and ⅛ of an inch thick, with a hole one inch in diameter cut in the center of each. The core is one inch in diameter and is built up of soft iron wires 4⅜ inches long. The fiber ends are forced onto the core, leaving 1/16 of an inch of the core protruding through the discs. This forms the spool, which is then wound with 2,500 turns of No. 22 D. C. C. wire. The distance between the fiber ends is 4 inches.

When the winding is finished, the coil may be mounted on the base by cutting out a wooden block, with one side hollowed out to conform with the shape of the coil and a thin piece of brass bent around the coil and fastened to the base, or it may be mounted on two brass castings, as shown at "E" in the drawing. The vibrator spring is best made of phosphor bronze, or German silver, 3½ inches long, 1 inch wide, and 1/16 of an inch thick.

The lower end is bent over at right angles to allow a means of fastening it to the base. A one inch disc of iron, ⅛ of an inch thick, is fastened to the vibrator spring at just the right place to come in front of the core, as shown. Two silver discs, one inch in diameter, are fastened, one to the vibrator spring and one to the adjustment screw, as shown at "S" in the drawing. These are best, when swetted on to the holding members, as they are only 1/16 of an inch in thickness and any method of fastening with a screw or rivet would be awkward. Care must be used to see that the entire flat surface of these contacts meet squarely, as they carry a very heavy current



BUZZER TRANSMITTING SET.

set up in the oscillating circuit. The post "C" which supports the adjusting screw "A" and contact, is made of ½ inch brass rod, which may be straight, or turned into a fancy shape as desired. It is fastened to the base by a brass machine screw.

The oscillation transformer "F" is made by winding one coil of two turns of No. 12 bare copper wire, 10 inches in diameter and another coil of the same size wire having 15 turns, 12 inches in diameter. The small coil is placed inside of the larger, with a one inch air gap between the two. The aerial connection to the outside coil is made adjustable, by using a spring brass clip, attached to the aerial wire, which can be moved from one turn to another, for adjusting the wave length. The condenser should be of the glass or mica insulated type and should have a capacity of .013 M. F. The circuit may be easily traced from the drawing.

The oscillating circuit is formed through the small coil, condenser, vibrator spring and contact supporting post, and this much of the circuit should be wired with No. 12 wire, as it carries approximately 40 amperes. This heavy current is set up by the oscillating circuit, although the actual power consumed on a 110-volt direct current is less than three-fourths of an ampere, so that the rest of the circuit may be wired with No. 18 copper wire.

Oakland is Active

The Oakland Tribune in California is planning to increase the power of its broadcasting station, and hopes by October to be in a position to apply for a Class B license. At present KLX is operating as a Class C station on 360 meters with a power of 250 watts. New apparatus for a 500-watt set has been ordered from the Western Electric Company, and with a 300-foot antenna, a far wider broadcasting range is planned this fall.

There are seven broadcasters in Oakland and its vicinity; two B stations and four A stations being in San Francisco, across the bay. The new G E station planned at Oakland will make a total of eight.

German Experiments

Experimental work in wired-wireless is progressing in Germany, Consul Richardson advises the Department of Commerce. Recently communication was effected between Berlin and Stolp on the Baltic coast over a 400 kilometer line. This high-frequency telephone line has been turned over to the Federal Post authorities by the firm of Lorenz A.-G. Three calls at a time were put through successfully; one on the normal wave length, another on 45 kilometer wave, and a third on a wave of 25 kilometers. Instead of cathode tubes, a special high frequency generator was used.

The Newest Radiotron, Model U V-199

By J. C. WARNER
Research Laboratory, General Electric Company

RADIOTRON UV-199 is a receiving tube of the high vacuum type which has been designed for operation on dry cells. The filament of this new tube requires only sixty milliamperes current which is supplied at a potential of 3.0 volts. Thus, the power consumed by the filament is only .18 watt.

This low current and small power consumption are made possible by the use of the new X-L tungsten filament which is being used in both the UV-199 and in the larger UV-201-A. This new filament requires much less current than the older type of tungsten filament and operates at a much lower temperature, appearing a dull yellow when lighted, while the older filaments burned at a brilliant white heat.

To illustrate the capabilities of the new filament, it is of interest to compare the UV-199 filament with that of the well known UV-201. The UV-201 filament required 1.0 ampere at 5.0 volts, that is 5 watts, and gave a total electron emission of 7.5 to 10 milliamperes. The UV-199 filament gives the same electron emission but requires only 1–16th of the current and 1–27th of the power.

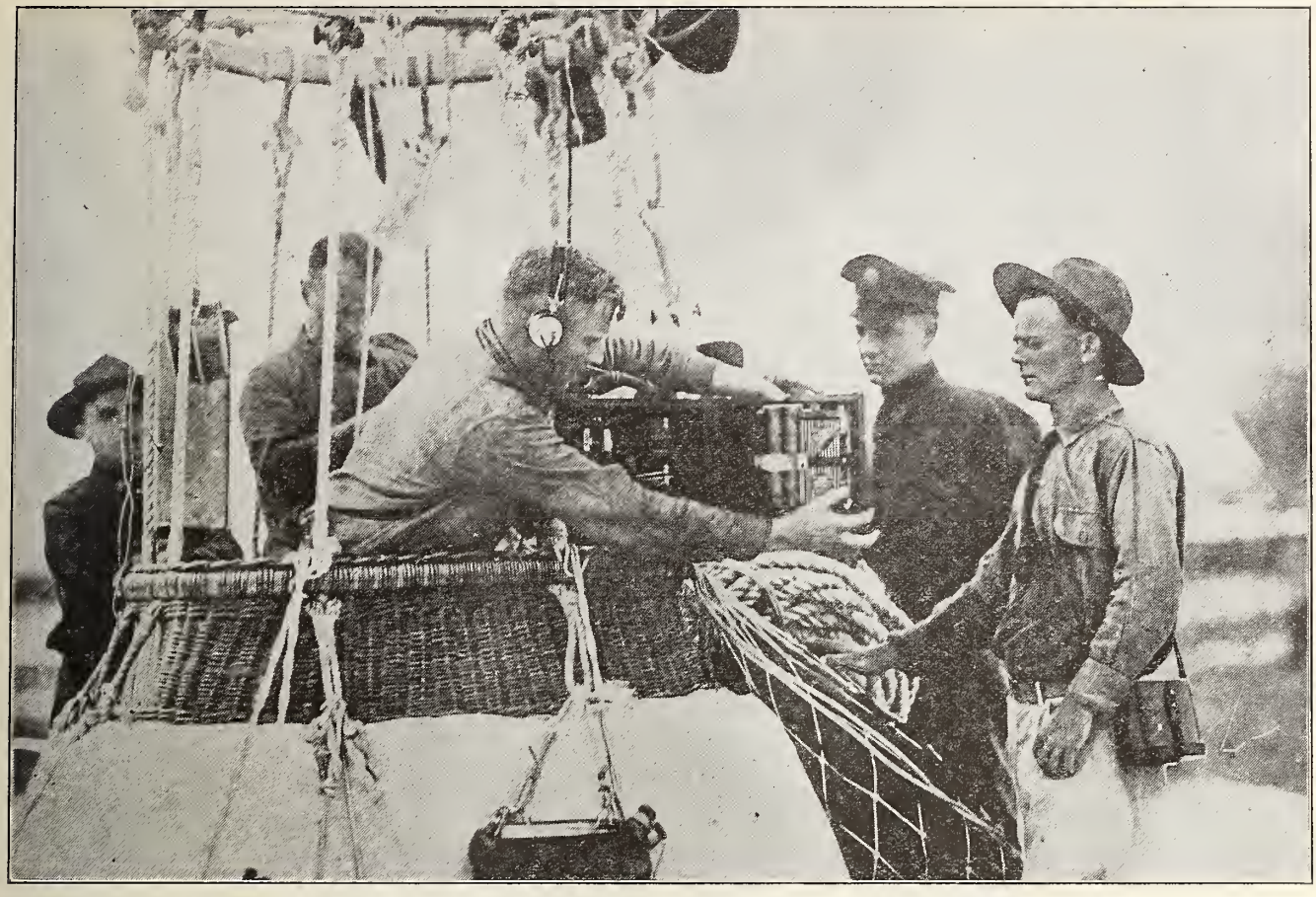
In order to operate at such a low current, it is, of course, necessary that the filament be of very small size, and in fact the UV-199 filament is only about one-fourth as thick as the average human hair. In spite of this small diameter, the filament is remarkably strong, since tungsten has about the same tensile strength as high grade steel.

The low filament current makes the UV-199 admirably suited to dry cell operation. It is always most economical to use dry cells at a low discharge rate; that is, the capacity of the cell in ampere hours is greatest if the energy is taken from the battery at a small current rate. Also, for greatest battery economy, the battery should not be discarded until the closed circuit voltage has fallen to 1.0 volt or less per cell. That is, although the voltage of a dry cell is often thought of as 1.5 volts, this is true only at the very beginning of the life of the cell. The closed circuit voltage drops rapidly at first and then more slowly until it has reached 1.0 volt the energy contained in the battery is practically exhausted and the battery should be renewed.

The UV-199 filament is designed for operation on three dry cells in series and so takes advantage of the economy of a low current rate and the 1.0 volt per cell end point. Three six-inch cells of the ordinary general purpose type will operate one tube two hours a day for 387 hours or 193 days, two tubes 200 hours, and three tubes 125 hours. It is even possible to use flashlight cells where minimum weight and size of set are required. A small flashlight bulb requires .55 watt or three times as much power as the UV-199 filament and an ordinary tubular three-

(*Continued on page 28.*)

Sunday afternoon crowd in a village near Havana, Cuba, listening to its first radio program. As usual, when the camera man comes around the crowd turns to look right in the eye of the lens. U&U Foto.



Lieut. R. S. Olmstead, winner of the National Balloon race, adjusting his lightweight dry cell radio outfit, prior to the start of the race from Indianapolis. Radio rendered material service to the balloonists through the broadcasting of weather reports from five principal broadcast stations. Photo by courtesy of General Electric Company.

Radio Aids Balloon Racers

STATIC, that mysterious interference in the reception of radio signals, which is perhaps one of the greatest puzzles to radio experts today, may be confined to an atmospheric belt about the earth. At least that is the possible conclusion reached in special tests made by Ralph Upson, one of the country's most prominent aircraft engineers who was a contestant in the National Balloon race which started from Indianapolis on July 4.

Upson's balloon was equipped with a powerful lightweight radio set by the General Electric Company. For six weeks preceding the race Upson had used the set in his home and thereby became thoroughly familiar with its operation under various conditions. His experience had taught him what static sounded like, and he also learned that the air seemed particularly filled with it when there was an electrical storm in the vicinity; so much so, in fact, that one of the uses he planned for his radio outfit in the race was to detect thunder storms before the lightning might be visible.

In his tentative report to the General Electric Company, made after the race, Upson writes:

"One of the outstanding happenings in the use of radio in the balloon race was that at altitudes of 3,000 feet and above we observed absolutely no static whatever, although we could see lightning at various points on the horizon."

Upson's chief purpose in carrying radio was to help him win the race. Five of the principal broadcast stations had arranged to send out special weather reports on upper air currents during the first night of the race and the following morning. In regard to this Upson says:

"Andrus, my aide, acted as chief radio operator. He began listening in at 8:30 o'clock the night of the race. At first he could hear nothing but code signals, concerts from various stations, and a radio drama that was being sent out from a Chicago station. For an hour, this was about all we could hear. Then at 9:45 o'clock, central time, Andrus picked up the latter part of the weather report being broadcast from WGY in Schnectady. We heard just enough of it to make us wish we had heard the entire report. However, our disappointment was short, for a few moments later the whole report was repeated, every word being received clearly and distinctly. It was just the news we wanted.

"As a result of the information, we decided to go a little higher but not to try any high altitudes unless forced to it by thunder storms. The report gave us full confidence of reaching New York State, and possibly New England. Everything seemed so favorable that I turned in to sleep, leaving the balloon appendix partially closed. Then came the accident and you know the rest, a forced landing."

Similar outfits were installed in the three army entries in the race by the Radio Corporation of America. One of this trio, Lieutenant R. C. Olmstead, won the race.

Remote Control Broadcasting

By ROBERT J. STANTON
Assistant to the Director, Station K. Y. W.

OUTSIDE broadcasting, or transmission of speeches and music by remote control, has now reached its perfection at KYW, the radiophone broadcasting station operated by the Westinghouse Electric & Manufacturing Company, at Chicago. Remote control broadcasting means that the talk or music to be transmitted is "picked up" in a concert hall or theatre outside of the building in which the sending apparatus is installed. Before being relayed through special wires to the powerful transmitting panel in the broadcasting station, it is amplified by equipment located in the hall where it is being picked up, which insures its reaching the sending set with the same volume and audibility as heard in the hall.

Remote control broadcasting has come to be one of the important factors in radiophone service, for without it transmission of concerts played by large orchestras would be impossible, as the studios of even the largest stations are not large enough to seat a thirty-five or forty piece orchestra or band. The services of the larger churches, such as the Sunday Evening Club and Central Church of Chicago, which have choruses of a hundred voices, would also be impossible to transmit if it were not for remote control broadcasting.

The first successful remote control transmission was accomplished by KYW shortly after the station began operating, when the productions of the Chicago Civic Opera Association were broadcast direct from the stage of the Auditorium Theatre, situated approximately a halfmile from the Edison building, on the roof of which the sending equipment of KYW is located. Due to the success of the first radio transmission by remote control KYW is now known as the first radiophone station in the world to broadcast complete productions of Grand Opera, which were heard last winter in every state in the union and in Canada and Cuba.

The first step in the process of this remote control broadcasting was the installation of specially sealed telephone wire connections from the stage of the Auditorium to the transmitting panel of KYW. Three extensions were then added to these lines, which in turn were connected to three microphones, placed in the footlights on the stage, one in the middle and one on each side. A microphone also was suspended from the front of the first balcony to pick up the heavy volume music played by the orchestra during the overture.

A control switch was then installed at the right side of the theatre, fifteen rows back from the orchestra pit. By means of this switch the operator on duty at the theatre was able to cut in the microphone before which the singers were performing, which aided him in establishing a uniformity in the volume of music being transmitted. In addition to being an expert radio engineer, it was also necessary for this man to be familiar with the action taking place in each production broadcast in order that he might know in advance if the artists were to shift their positions from the center of the stage to the right or left and whether a solo, duet, trio or full chorus was coming next.

During the broadcasting of each production, this man also was in direct communication with the operator in the station, in order that he might be immediately informed if a reduction in the volume of music should occur. If this did happen he could immediately switch in one of the other microphones and correct the trouble before the audience might discern a change.

From this beginning, the directors of KYW have gradually installed additional remote controls until at the present time there can be picked up music and speeches from ten outside sources. Special wires now connect the station with three of Chicago's leading hotels, three theatres, one newspaper office, two concert halls and a trading floor. These remote controls enable KYW to broadcast a variety of material, including commercial and financial reports, news bulletins, concerts, dance music, speeches and Grand Opera. Due to this system of outside "pickup," speeches by prominent statesmen visiting Chicago may be transmitted without the necessity of their making a special trip and second talk in the studio. The same is true of special concerts and other

(*Continued on page 18.*)

Remarkable cloud photograph taken by Ralph Upson during the recent championship balloon races, won by Lieut. R. C. Olmstead.

Telephoning Over Power Lines

TELEPHONING over power transmission lines became an established fact this week when executives of large power companies from various sections of the United States formally opened the new high frequency automatic telephone system just installed on the lines of the Consumers' Power Company, of Michigan. The celebration was in charge of B. E. Morrow and C. W. Tippy, officials of the Consumers' Power Company, who were first to talk over the new system. Each visitor, as he was allowed to hold conversation with the load dispatcher and operators in a power plant fifty miles distant, marveled at the extreme clearness with which conversation could be conducted.

This system has just been installed by engineers of the Westinghouse Electric & Manufacturing Company, who were also present at the opening. Only two sets are completed, these being located at Jackson and Battle Creek, Michigan. While these two cities will be able to use the apparatus, four other similar sets will be installed. In all there will be six hundred miles of transmission line utilized for telephone service when the system is completed

This installation is a long step in advance of anything yet attempted in experiments with socalled wired wireless. Previous installations have been but adaptations of the familiar radio transmitters and receivers used in sending and receiving radio telegraph and broadcasting, and provided only one-way communication.

The system as worked out is quite flexible. Two frequencies are used. The dispatcher's set transmits approximately 50,000 cycles and receives 60,000 cycles. The transmitter at Battle Creek transmits 60,000 cycles and receives 50,000 cycles. In effect, there are two transmitting sets and two receiving sets in service working through single telephone instruments with the result that the service is duplex and both parties may talk and listen simultaneously.

To communicate with Battle Creek, the load dispatcher at Jackson has only to lift his telephone receiver from the hook. This automatically lights the tubes and starts up the radio transmitting apparatus about half a mile away in the Jackson steam plant of the company. The dispatcher then turns the dial on his instrument to the number assigned to the Elm Street steam plant in Battle Creek. The operation of this dial sends out modulated high frequency impulses over the high tension transmission line through a sending antenna strung parallel to the power line for about 1,000 feet. These impulses are picked up on the receiving antenna at the Elm Street plant and cause a selector there to step around and stop at the proper point and, through the operation of a system of relays, rings a bell or sounds a horn in the booth of the Battle Creek station.

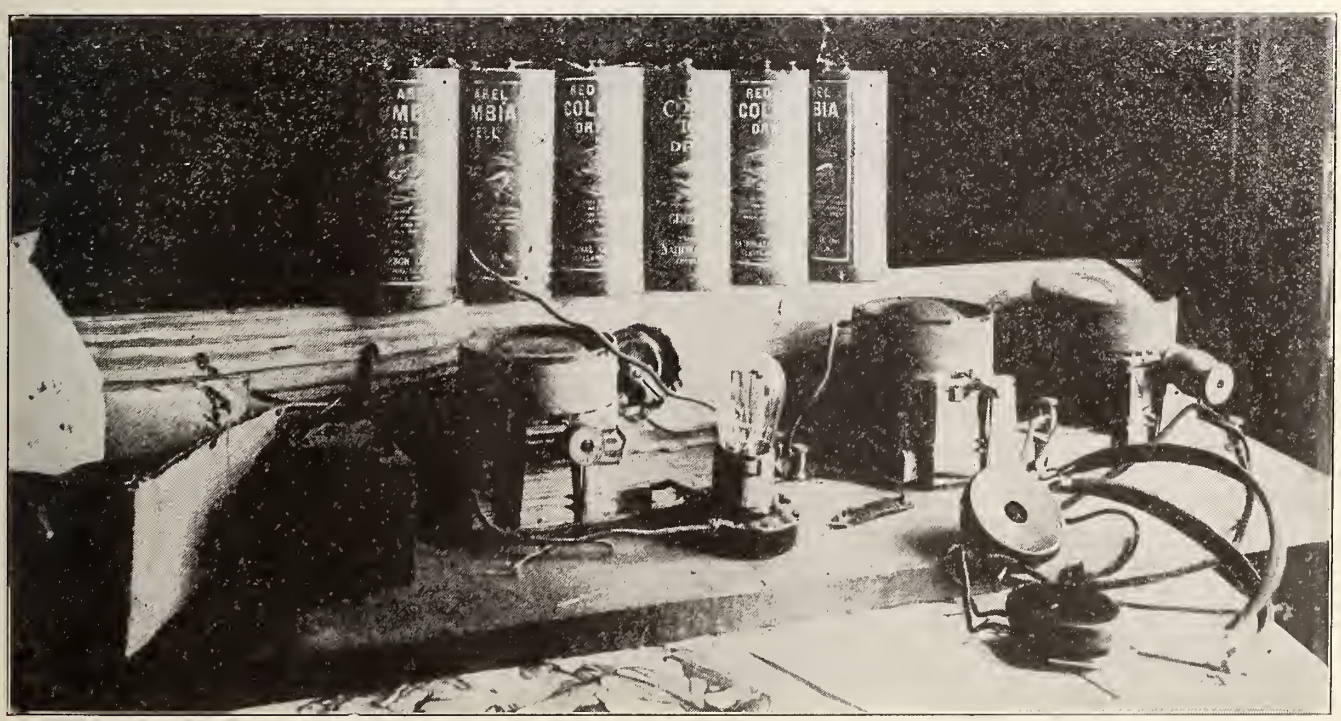
The Battle Creek operator unhooks his telephone receiver. This automatically starts up the transmitting radio set at Battle Creek. He then hears the Jackson voice sent out by the Jackson transmitter, and Jackson hears his voice which goes out through the Battle Creek transmitter. The two voices pass each other carried on different wave lengths, going through different transmitting radio units, but all is tied into the two ordinary telephone instruments and controlled through them.

One of the principal difficulties which had to be surmounted in the full development of this system of communication was to neutralize the currents induced in the receiving antenna by the powerful currents in the transmitting antenna. Every radio fan knows how difficult this would be from his experience with the squeals and howls from even the small receivers in his immediate vicinity. This end is accomplished by apparatus in the balancer box at the left of the radio receiver. When properly adjusted, this balancing apparatus serves to neutralize the currents induced by the transmitting antenna in the adjacent radio receiving circuits and thus permit simultaneously the two-way communication which is a essential factor to the commercial development of high frequency telephony.

Operation of the system is so simple and so stable that it gives not the slightest hint of the months of study and experimentation that have taken place in the Westinghouse organization to combine the automatic telephone and radio elements for transmitting over lines which carry current at such tremendous pressures as to approach in volume of energy the power and effect of a bolt of lightning.

While the radio impulses which transmit the voice are carried upon the high voltage power lines, tests have shown that in event of line failure, the radio impulses jump the gaps and communication is not interrupted even when several miles of the transmission line is down.

(Continued on page 20.)



Spools and oatmeal boxes went into construction of this set, but George Stahlman of Nashville, Tenn., has picked up New York, Detroit, Fort Worth and Atlanta. In addition to getting good results, he has the satisfaction of having made his own outfit. U&U Foto.

Here's a Few Pickups of Our Own!

THERE probably is no better magazine salesman than a satisfied reader to whom we have rendered some little service or other. We take pride in saying that here is the keynote of our rapidly increasing circulation. The following extracts are taken from many letters from our readers who write in and tell us what they think of Radio Age.

Mr. E. Johnson, of 305 West 149th St., New York City, writes: "I received your diagram of the Reinartz circuit, and thank you for same. If you will forward me a subscription blank by return mail, I shall subscribe to your magazine with pleasure."

William S. Law, of Saxon Mill, Spartanburg, South Carolina, one of our regular readers who figures prominently in our "PICKUPS BY READERS" with a set constructed from instructions given in Radio Age writes: "I have just sent in my subscription for your magazine. Have been buying it every month on the stands but I do not wish to take a chance of missing a number. I think it has more helps and diagrams useful to the BCL than any other magazine."

"First of all, I wish to mention that I received the first issue of the Radio Age and find it chock-full of radio knowledge," says Mr. S. Sabo, of Quincy, Illinois. "It certainly cannot be beat."

Carl Lagergren, of Osterville, Mass., writes: "I was reading another radio magazine when the postman brought my Radio Age. The magazine I was reading contained an article on an interesting circuit but lacked detail enough for me to construct it. I wish Radio Age would print this circuit with a description of its construction, because then I know it would be made clear enough for the rank beginner to construct it."

Here's a letter from an Indiana BCL:

Technical Assistant,

Radio Age:

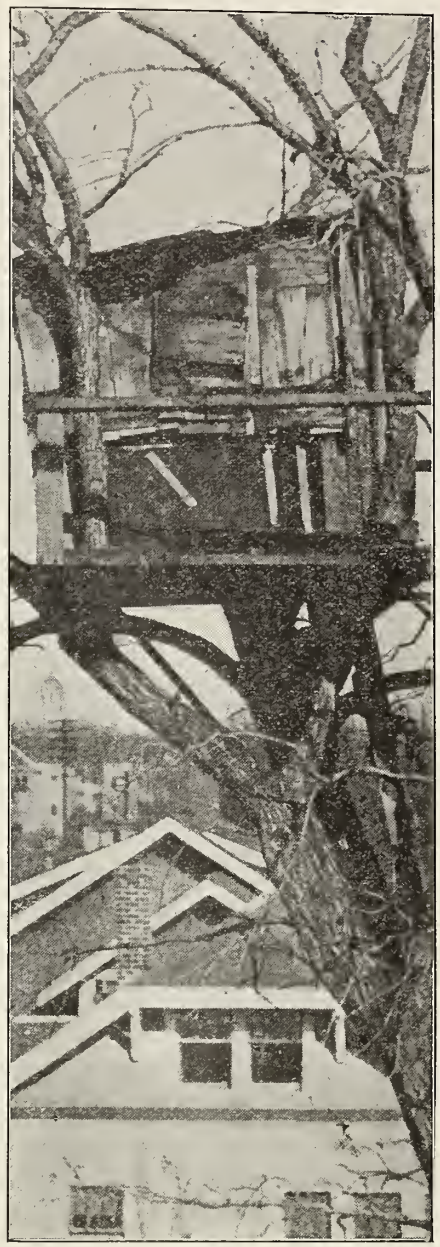
I herewith wish to thank you for the copious information you gave me some time ago in regard to a radio circuit diagram. You sent me much more information than I had asked for and expected. As much as I would like to, I am sorry to say I am unable to subscribe to Radio Age due to the fact that the institution I am attending prohibits its students from receiving secular magazines. If no such limitation were imposed, Radio Age would be the first magazine I would subscribe for. At my home we get Radio Age regularly from our local newsdealer, and I eagerly read it during my off months. It is certainly a magazine of high caliber, full of practical information. Thanking you again for your courtesy to me, I am,

Very truly yours,
JOSEPH A. TERSTEGGE.

Saint Meinrad, Ind.

Richard F. Krouse, of Wauwatosa, Wis., says: "It gives me pleasure to be able to say that I am a subscriber to your good magazine, Radio Age."

With regard to our instructions, E. T. Siegerdt, of Chicago, writes: "I am a regular reader of Radio Age, and have constructed the W D 11 tube circuit of the March issue, and it works beautifully; in fact, better than any other circuit I have built." Mr. Siegerdt wanted information on how to further improve his set and got it.



Howard Bussman, of St. Paul, Minn., has built him a tree-top laboratory where he can make all the noise and all the dirt he likes. U&U Foto.

To substantiate our first contention that a satisfied reader is a standing advertisement, we quote Mr. A. Sohval, of New York City, "I am always purchasing your publication from the stands, and whenever the opportunity presents recommend it to others."

Radio Age always welcomes constructive criticism as demonstrated in the action taken in regard to the following letter:

Radio Age:

Being a subscriber to your valuable paper, I notice the article concerning the case of a man in Dwight, Ill., who has entered suit against an amateur radio operator charging excessive interference. I would appreciate further details of this case as it progresses. Your magazine is complete in everything but one instance, which is that I think that it might be improved by adding a list of the Canadian stations, their call letters and other information to your present list of "Corrected List of United States Broadcasting Stations."

Very truly yours,
Stockton, Ill. JOHN MAHER.

Our issue of Radio Age immediately following the receipt of this letter contained the addition of the list of Canadian stations. Don't forget that Radio Age always welcomes suggestions of this kind, and the Editor really delights over such letters, when they contain matter showing that our readers really take so personal an interest in the magazine.

With further reference to the explicit directions and conciseness of Radio Age instructions, we print the following from a letter written by Mr. B. Magruder:

"I have tried innumerable places to get wiring illustrations of various circuits. I wish to build the Kopprasch circuit and I should like it very much if you will furnish me with a drawing or other similar data which would show the arrangement, wiring and layout of the Kopprasch circuit as clearly as that of the Erla circuit in your May issue. It was very simple to understand and I am sure I could not go wrong if I had such a plan to work from."

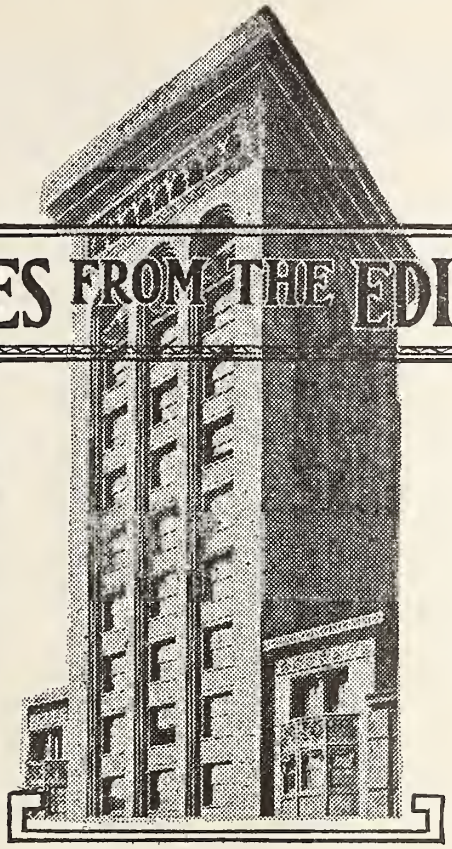
George W. Mayheray, of Chicago, Ill., wrote:

"Enclosed please find check for $2 for one year's subscription to Radio Age. I am a new hand at radio and would like to construct a three-tube W D 11 set. Now I find that it would be impossible for me to construct a set from the usual instructions given, but feel confident that if I had a panel arrangement of a circuit as clear as that of the Erla circuit in the May issue I could build the circuit with ease. I think that this method of presenting circuits and ideas is a really wonderful plan for the true amateur like myself."

And you should have seen our Technical Editor, Frank D. Pearne, change his broad smile into a good-natured grin when he read this well-deserved praise, written by Mr. Mayheray:

"Mr. Pearne, you being the greatest Radio expert of today, I know you will help me as you have thousands of others. Therefore, I am thanking you in advance for much much-needed assistance in the matter of making my first attempt at radio a success."

And if you have a suggestion, or a kick, containing something of constructive nature, don't tell your wife or your cat about it. Tell us—we'll welcome the receipt of such information.



THOUGHT WAVES FROM THE EDITORIAL TOWER

THE writer has heard sufficient copyrighted music broadcast from radio stations that apparently are fighting the music combine to establish test lawsuits for the rest of time.

There have been many columns written about a suit against a big department store in New Jersey, brought by the American Society of Composers, Authors and Publishers. The suit was heralded as the first big step in the fight to settle the question as to whether the broadcasters could legally be forced to pay fees for broadcasting copyrighted music.

Great! We shall await the result of the suit with interest. Meanwhile the wide world is broadcasting copyrighted music and except for a period of non-copyrighted music in the middle west, the fans have scarcely been aware that any fight was on.

Whether it is legal or not, broadcasting stations from coast to coast are shooting the copyrighted jazz stuff out every night and it may be that the music combine is not so thoroughly convinced that broadcasting is bad for the music business as we have been so emphatically assured.

IN OTHER columns there will be found an item in this issue about how the United States Shipping Board station in England is making some distance records, reaching Panama with uniformly good results during the hot weather; also there is an item to the effect that communication between Singapore and the Christmas Islands is carried on successfully in these hot days. There is other and convincing evidence that radio is effective in hot weather if the proper equipment is used.

It is to be regretted that early in the radio game there was so much foolish discussion of static in summer. The difficulties of reception were exaggerated in publications and by word of mouth. The belief in the static bugaboo became so general that many hard-headed business men simply refused to try to sell radio goods in the summer time, even going to the extent of ordering their purchasing departments to let the depleted stocks of equipment remain depleted, whether there was demand for equipment or not.

As a matter of fact, there is a lot of fun in radio the year 'round. It is possible to get long distance reception, if the receiving station is properly built and operated.

The only logical reason for a falling off of radio activities in the summer is that so many fans leave their homes for extended vacation outings and even when they remain at home outdoor pleasures often call them away from the radio receiving set. But that situation is met with the tendency nowadays to take a vacation radio set along and use it on the lake or in the camp.

An analysis of the situation shows that business in radio lines this summer is better than it was last summer and everything points to better business next summer than this summer.

Everybody is looking forward to the autumn months for the beginning of their promotional publicity, including advertising, and for extensive sales promotion.

It would be well for the trade to keep in mind that this summer slump is likely to be shorter than that of last season. Publicity and advertising campaigns started in September and October will be too late to get the results that are awaiting us in the late fall and middle winter. This magazine is practicing its own preachment, having started its promotional work in July.

It is going to be a big year in radio.

ON ANOTHER page we are publishing extracts selected at random from the many letters we are receiving from fans expressing appreciation of the helpful diagrams and clear information we are publishing about making and operating radio sets. Let our hook-ups be your guide.

Mythical Static

The United States Shipping Board reports that with the two kilowatt arc and chopper installed on the steamship, "Eastern Glade," reliable night communication was accomplished on 600 meters from Durban, South Africa, to Madagascar for a period of over a month. The distance between the above mentioned places is approximately 1,200 miles.

The Shipping Board receiving station at London reports that for the past two years they have had much heavier static in winter than in summer and that although heavy static has been experienced during the past winter, receiving conditions have now greatly improved.

Your Station

Radio Age wants photographs of stations and laboratories of its readers, in order that other fellows may see what a good layout looks like. Photographs should be gloss prints and should be as clear as possible. For each photograph accepted we will pay $1. Send them in, fellows—here's a good chance to see your station in print.

Timbuctoo Next

Radio communication between Singapore and Christmas Island was established recently, a report to the State Department advises.

Governmental Radio Activities

By CARL H. BUTMAN

WASHINGTON, D. C.—The United States Government has in operation today 885 radio stations, the Navy leading with 533 ships and 52 land stations, the Army being second, with 180 land stations.

Co-ordinating the service and equipment of these Government stations is one of the chief functions of the Interdepartmental Radio Advisory Committee, organized by Secretary Hoover soon after the first radio conference. This committee, which is composed of experts and representatives of Governmental departments taking an active part in the use of radio and broadcasting, has made a survey of the equipment and service of all Government stations, and has assigned new frequencies and wave lengths to them in accord with the recommendations of the Second National Radio Conference.

Generally it is felt today that the committee is a satisfactory clearing house for official radio activities. While broadcasting has been operated fairly satisfactorily so far, it is felt that the experience gained should form the basis of a national plan for a Governmental broadcasting system. This question members of the Committee realize, is intimately related to the 592 privately owned and operated broadcasting stations. They point out that "if radio is to become of maximum benefit to the people, the Government must continue to study the question of properly organized radio broadcasting and other services." There is a constant demand for curtailment and extension of the Government's activity and they feel that their duty is to co-ordinate those needs and execute them with maximum economy.

In the beginning the committee dealt only with broadcasting. Various problems arose which indicated the desirability of extending the scope of the work to include a wider field than radio broadcasting. This was done by Secretary Hoover to cover matters pertaining to radio communication in general. The functions of the Committee are to remain purely advisory . . . to all the participating departments in matters coming under its cognizance.

The Chairman of the Committee is Acting Assistant Secretary S. B. Davis of the Department of Commerce, who serves as the representative of that Department. The membership also includes the following representatives of the Department of Agriculture, Bureau of the Budget, Office of Chief Coordinator; Department of the Interior, Interstate Commerce Commission, Department of Justice, Department of Labor, Navy Department, Post Office Department, U. S. Shipping Board Emergency Fleet Corporation, State Department, Treasury Department, War Department.

The committee began an experimental system of "primary" broadcasting stations for the transmission of official government news by continuous-wave (code) telegraphy, this news being available to approved privately owned broadcasting stations for re-broadcast by radio telephone. Use has been made solely of previously existing stations. Seven Post Office Department (Air Mail) stations were used at the outset, and have been replaced by the following Navy stations, working on frequencies between 50 and 65 kilocycles (between 6000 and 4600 meters); Arlington, Va., Great Lakes, Ill., New Orleans (Algiers), La., San Francisco, Calif. These primary stations accomplish the same purpose as leased wires in supplying material to the radio telephone broadcasting stations.

There is one government radio telephone broadcasting station—NAA—that at Arlington, Va. Its frequency, under the new assignments, is 690 kilocycles (435 meters). It broadcasts lectures market news, and miscellaneous information, supplied by the Departments of Agriculture, Commerce, Interior, Labor and Treasury, and also music by Government bands. The schedule includes eighteen 15-minute periods of radio telephone broadcasting daily.

Today about 100 privately owned broadcasting stations are supplied with material from several Departments and authorized to broadcast it by radio telephone.

"It is impossible to state the cost of broadcasting by Government departments because such operations have been conducted in connection with the other regular radio work of the departments," the committee states. The cost of conducting the broadcasting by Government stations during the past year included $13,800 for equipment at Navy stations, including installating, alterations, power and renewals. There was no equipment charge against broadcasting by the Post Office Department stations, but the operation cost at the Post Office Department stations was approximately three cents per word. The average cost of the broadcasting from all seven Post Office stations for one day on a fifteen-hour day basis was $53.93 or $16,826 per year. The Committee has no estimate of the operation cost of the broadcasting from Navy stations, nor of the cost of preparing the material.

The classification of material for broadcasting is considered, and it has adopted the principle that radio broadcasting should not be used where wire telegraphy or printed publication would be as satisfactory.

Radio Gunners

It is expected that the Naval Bureau of Navigation will hold an examination for gunner—radio—about the middle of August. The Bureau will notify the service at large as soon as it is definitely scttled. In all probability, requirements for this examination will be the same as those incorporated in the Bureau's manual. This is a step in advance for radio in the navy as the gunner is a warrant officer and stands next to the commissioned personnel.

Reinartz Book FREE

Reinartz Radio Book with Hook-ups—best book on best circuit —written and illustrated by Frank D. Pearne. If you want one free sign the coupon below and get the book and one year's subscription to Radio Age for $2.00.

RADIO AGE,
500 North Dearborn St.,
CHICAGO.

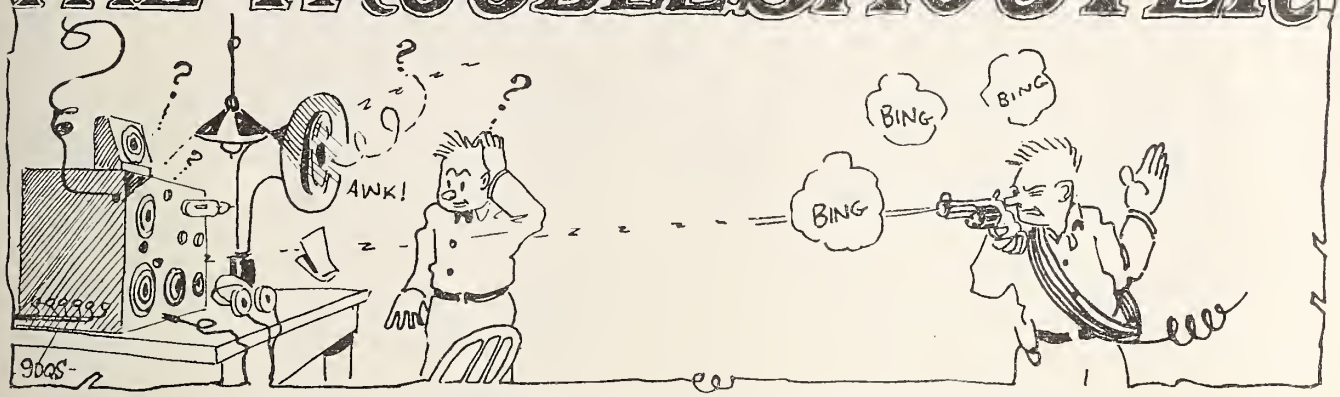
Please send me FREE one of your Reinartz Radio Books and send me Radio Age for one year. I want to take advantage of this Special Offer. I enclose $2.00.

Name.....

City.....

Street and Number.....

THE TROUBLESHOOTER



The technical department sends out many replies to questions in each day's mail. This service heretofore has been free to all but in order to assure this service to our subscribers this direct reply method hereafter must be restricted to those fans who are on our subscription list.

Fans who are not subscribers may obtain this service by enclosing 50 cents with their question and the reply will be mailed at once, accompanied by circuit diagram where illustration is needed.

All inquiries should be accompanied by self-addressed and stamped envelope.

R. C. G., Chicago, Ill.

Question: I wish to ask a few questions with regard to charging a battery. I am on a direct current circuit for house lighting, and therefore could use the socket light for charging my storage battery but I am unable to determine exactly how much resistance I should have in the line, and the safest type to use. I have an electric toaster of 550 watts type of 5 ohms resistance, and would like to know if this would be a satisfactory resistance? How would this be connected? How long should the current be allowed to charge for an 80 ampere hour battery? How is polarity of the direct current determined? How can I tell when my battery is fully charged?

Answer: In Figure 1, I am printing the correct arrangement for charging the battery you speak of using the direct current lighting source you have. The toaster in series with several lamps of about 100 watts will sufficiently cut down the current to make it safe. The circuit should be properly fused at all times. If the battery boils violently another lamp should be added until the plates just bubble profusely. To determine when the battery is charged, I would advise that you secure a hydrometer, an instrument costing about seventy-five cents from your local battery station and by following the instructions accompanying the instrument you can test your battery for its gravity at any time. A fully charged battery should read 1280. The description of a polarity indicator is described elsewhere in this issue.

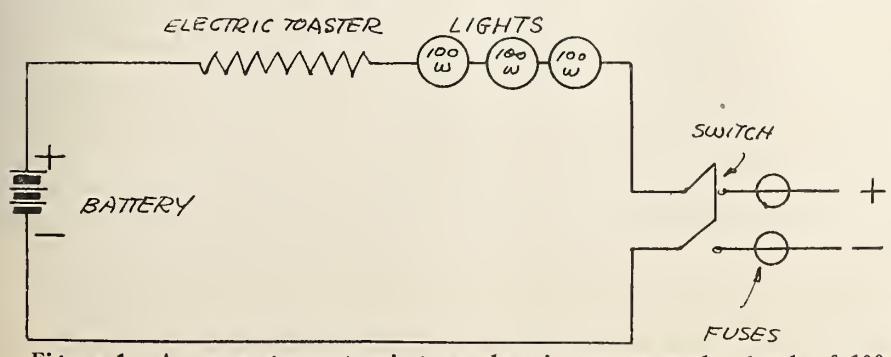


Figure 1. An arrangement using an electric toaster and a bank of 100 watt lamps in series to charge storage batteries, where direct current is available.

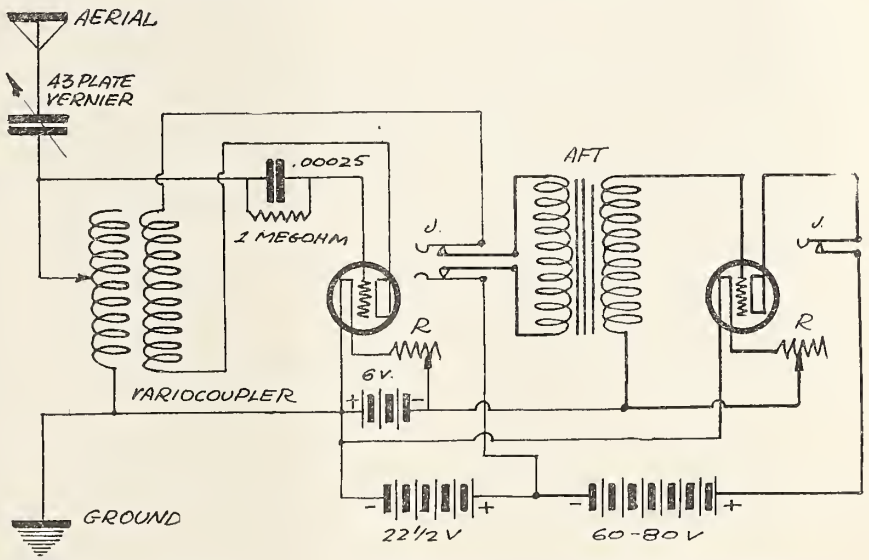


Figure 3. The single circuit regenerative set, showing the addition of one stage of AF amplification.

T. McL., Brooklyn, N. Y.

Question: In your May edition of Radio Age, on page 21, I saw a drawing of a single tube regenerative set sent in by Harold Lee, of Fosston, Minn. I made one exactly like the drawing but am unable to get any long distance outside of WOR and WJZ both being located in Newark, N. J., about sixteen miles from here. I can get WEAF in New York City very loud and also the two stations in Newark but no further than that. WGY I cannot get or Philadelphia, Pa., which are about 100 miles from here. Do you think an amplifying bulb would be of any assistance in getting these stations? There is a fellow near me who can get

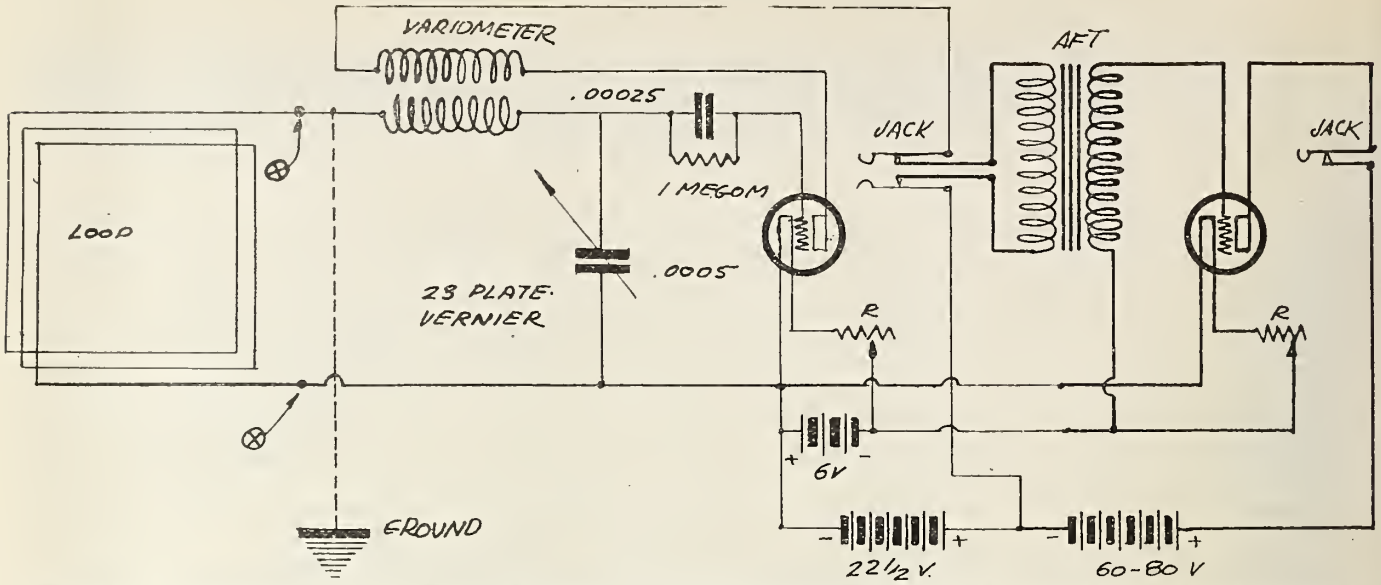


Figure 2. A simple loop circuit with one stage of AF amplification which can be converted into a regular aerial receiver by connecting an ordinary variocoupler at the points marked X.

Boston, Atlanta, Washington, D. C., etc., and he uses a one-stage amplifier along with the set. Will you kindly show how this is added?

Answer: In Figure 3, I am printing a diagram showing you how to add a one-stage amplifier to the set you have connected up. I feel confident that if you will give careful attention to the adjustment of your tube on the detector you will find that your range will increase. Probably the best way to do this is to secure another tapped B battery of 22½ volts potential and arrange it so that it is adjustable in steps of 22½ volts up to 45. You will then be able to get these long-distance stations as you wish. The set should be adjusted so that it spills over gently when the secondary of the variocoupler is turned, i. e., it should give a dull click or soft thump followed by a continuous hissing sound. If you find that the set gets the carrier waves or whistles and does not seem to be able to tune in the voice, decrease the B battery. Be sure that the filament battery is in good condition. No doubt you will also find that your set will have a better range in the fall, due to the fact that summer weather makes the reception of long distance difficult.

C. M. H., Seymour, Ind.

Question: I have a two-step amplifier, which when I first purchased it would not work and after corresponding with the manufacturer sent it in and it was repaired and returned. It worked fine for awhile, and then died again. Thought probably the transformers had gone bad and installed new ones. I am still having trouble, and would appreciate a little assistance from you. Have drawn the hookup I use, and would like to have you finish same from output of detector to output of second stage. I want to use jacks and plug. Am not familiar with the latter and would like for you to show which are open and closed.

Answer: In this issue of the magazine you will find an article on the construction of a two-stage amplifier, using jacks, which will no doubt clear up your trouble.

T. O. W., Houstonia, Mo.

Question: I am enclosing a diagram of a radiophone hookup which I am using and I would like to know how to hook one stage of radio frequency amplification to this. Would also like to have you show the detector of the circuit independently.

Answer: In Figure 4, I am showing you how to correctly add one stage of radio frequency amplification to the circuit you are now using. The detector as you ask was shown in the May issue of Radio Age.

H. R., Schenectady, N. Y.

Question: In the June number of Radio Age I noted with interest your description and drawings of the Kaufmann circuit, but am at a loss to know what size panel it will take. Was under the impression that it could be put on a panel 8 by 18 inches but notice you have the 43-plate condenser mounted directly over the Active 20-coil. This being the case, it would take a panel about 12 inches high instead of 8 inches as per the directions. The coil would take 5 inches and the condenser about 4 and with about 2 inches leeway it would make the panel pretty large. Would appreciate it very much if you could send me a template of the panel showing the correct size and spacing of the different instruments. Also note you have the 43-plate condenser mounted upside down. Is this essential?

Answer: The Kaufmann circuit can be easily mounted on the size panel as given. The Active 20-coil is not mounted directly below the condenser, but is mounted in back of it with the taps directly underneath the condenser. The coil may be set 3 or 4 inches back on the mounting board. I am sorry to say that I have on hand no template with which you could lay out the circuit. You will no doubt wish to use apparatus of your own choice, and of course the holes will have to be made in accordance with the instrument you use. The condenser is apparently mounted upside down as it has been found that this arrangement collects less dust and dirt.

B. B. J., Rock Island, Ill.

Question: Please advise just what receiving range could be obtained with the Erla circuit at this time of the year. What will the new Kaufman circuit accomplish in comparison with the Flewelling or Reinartz circuits? How are the U V 201 A tubes used? I have a perfectly good storage battery and would like to use it with this tube if the expense of additional apparatus is not too great.

Answer: Both the Erla and Kaufmann circuits are giving good results; however, will say that I am partial to the Reinartz circuit as the set for the beginner, due to the fact that it is easier to construct, least difficult to operate, and can be constructed at a minimum expense. With a Reinartz set using one tube a conservative range of 800 miles at night may be expected under favorable receiving conditions. You will not have to change the circuits at all in order to use the U V 201 A as only a special type of rheostat of higher resistance than the ordinary one is needed. If you use the tube with a regular rheostat, the knob should be turned so that the bulb barely lights. There are several small resistances on the market which can be added to the regular six ohm rheostat to make it more efficient for use with the U V 201 A.

A. C., Brooklyn, N. Y.

Question: Will you kindly print a good hookup for a set using the following apparatus in connection with a two-stage audio frequency amplifier. I have an outdoor antenna, 3 W D 11 tubes, sockets, 2 AF transformers, 2 double sockets, 2 AF transformers, 22 double circuit jacks, 1 single circuit jack, 1 variocoupler, 1 variometer, 2 variable condensers and a pair of Murdock phones.

Answer: A very efficient circuit was printed in the July issue of Radio Age, using the very apparatus you mention with the addition of a 25-turn honeycomb coil placed in the grid return circuit. If you will look back for this circuit and add to it a two-step amplifier as described in this issue, you will have a very efficient set. This circuit will give

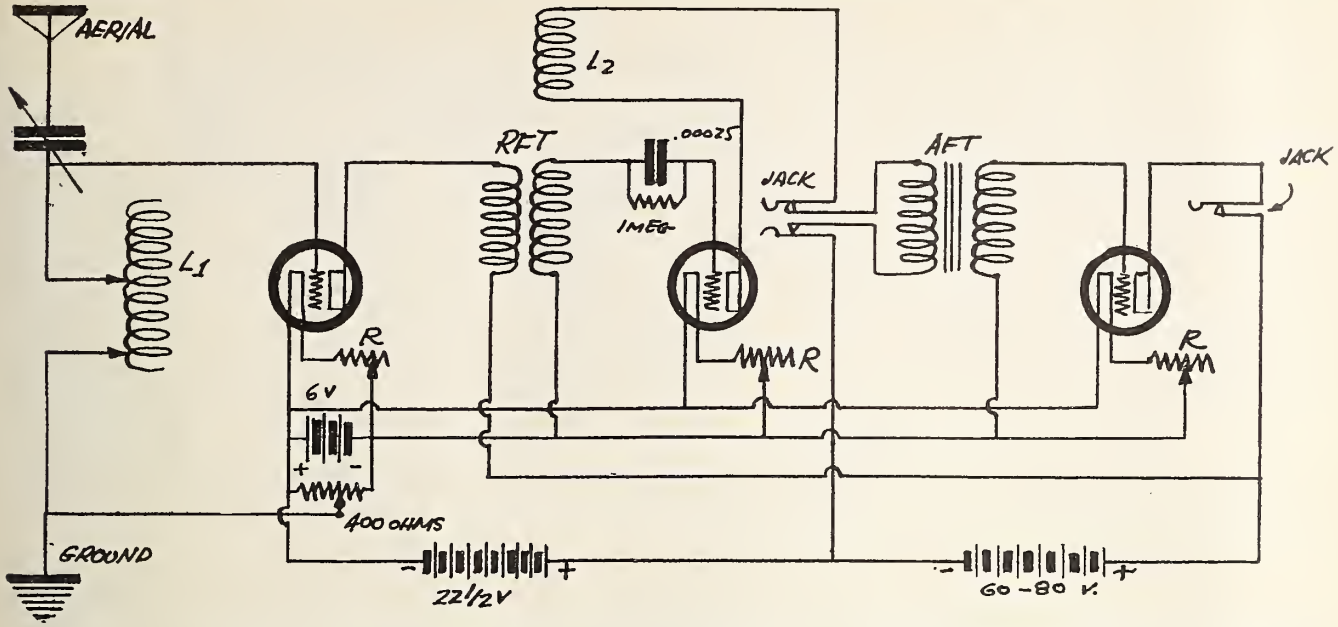


Figure 4. A single circuit regenerative circuit in connection with 1 step RF amplification and 1 step AF amplification. L 1 and L 2 are the primary and secondary of a variocoupler respectively.

ample selectivity and good range. The circuit appeared in the questions and answers section.

H. B. K., Chillicothe, Mo.

Question: Kindly print a hookup of a circuit showing one stage of audio frequency amplification in connection with a circuit using either a loop antenna or regular aerial. The set is to be used with U V 199 tubes throughout.

Answer: In Figure 2, I am printing a circuit showing a loop receiver arranged to use either an aerial of the regular type or a loop. The audio frequency amplifier is shown in darker lines. The amplifier may be constructed according to the instructions given for a two stage amplifier given elsewhere in this issue.

C. H. P., Davenport, Ia.

Question: Please send me a diagram of what you consider the best circuit using detector and 2-stage of audio amplification for use with either loop of regular antenna. I am in search of a circuit that will give me volume as well as distance, regardless of cost of building. I have a Reinartz spider web coil set, built according to your instructions and am having wonderful results with it but I am in the market for something more elaborate. This circuit is to be used for broadcast reception only.

Answer: You will want a selective, efficient circuit, such as I am printing in Figure 5. From personal experience, can say that it is yet the most efficient circuit I have used, and will give unlimited range if properly constructed. The radio frequency stage is shown to increase the range of the set, with the two stage audio amplifier, which can be constructed as shown elsewhere in this issue, will give plenty of volume. This circuit requires patience and skill in tuning, and you will have to adapt yourself to the noises and sounds of the set to get the best results.

J. A. O. B. Brooklyn, N. Y.

Question: In the May issue of Radio Age, you featured the Erla circuit, which I constructed according to the instructions given. I am enclosing herewith a diagram showing how I have connected the set and with which I am getting good local results but with little success on long distance stations. Is the enclosed diagram correct? Would the addition of more tubes assist in bringing about better results? I have a 75-foot aerial; would it be a good plan to put a condenser in the ground lead? I would like to have as powerful a set as possible and would like to have your opinion with reference to this.

Answer: I am mailing you a diagram which shows the limitations of your set,

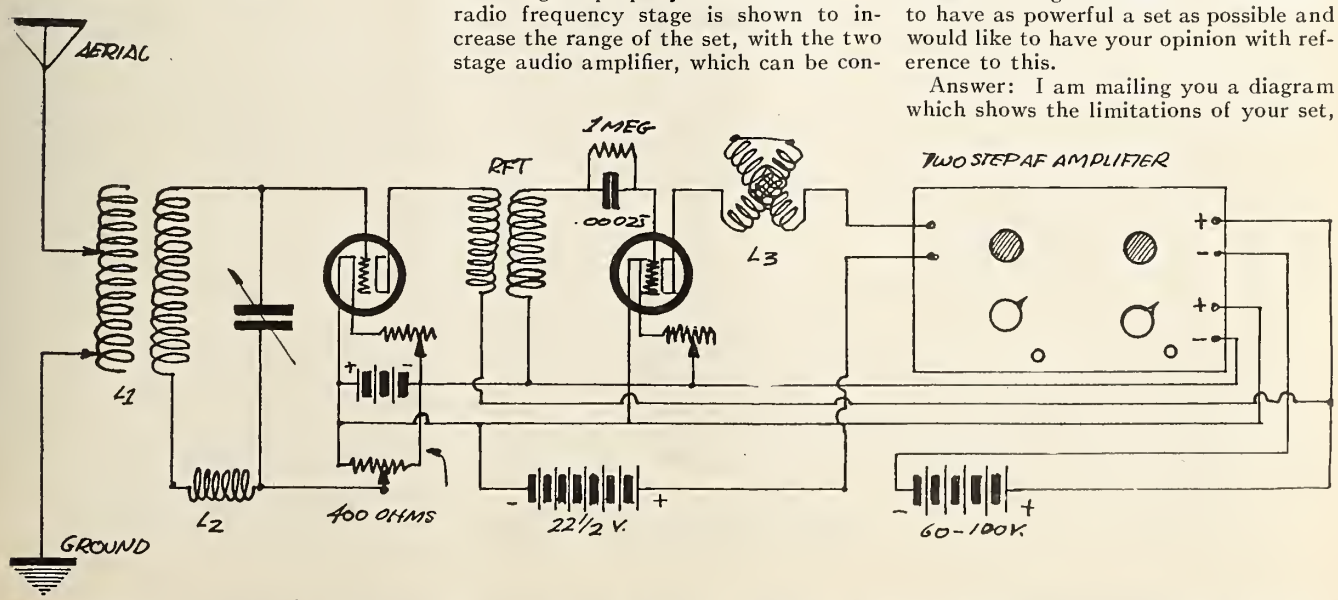


Figure 5. A simple regenerative circuit of great efficiency, 1 stage of radio frequency amplification, and two stages of audio frequency amplification. L 1 is an ordinary variocoupler, L 2 a 25 turn honeycomb coil, and L3 a variometer. The drawing illustrates the use of the audio frequency amplifier described in this issue.

due to reversed transformer connections. It is important that you have these connections correct. On your diagram you indicate the connections from the G on the reflex transformer going to the positive of the AF transformer, and the A on the reflex transformer connected to the P on the AF transformer which is incorrect. Correct connections are G of the reflex transformer to P on the AF transformer, and F— on the reflex transformer to B+ on the AF transformer. The correction of this error will greatly improve the efficiency of your set. Would advise that you shorten your antenna down to about 50 feet and forget about inserting a condenser in the ground lead.

J. N., Chicago, Ill.

Question: I have constructed my set in accordance with the hookup in your booklet, "Reinartz Radio." On the antenna I have a 23-plate condenser and on the ground an 11-plate. I use a Schoonover coil and am able to get local stations loud enough on the detector tube so that they can be heard all over the room by using an adapter on my victrola. However, I have not been able to get out-of-town stations even with one step of audio frequency, although I have friends who get distant stations loudly on the Reinartz sets with only a detector tube. I have therefore tried to add a step of radio frequency to see if this would bring in the distant stations. I have an Erla A B 1 transformer mounted in a bulb socket and am using a C 301 A tube as a radio frequency amplifier. The addition of this apparatus has not helped the situation a bit. All I get now is a humming sound and weak signals from local stations. I can turn off the radio frequency tube or even remove it from its socket, and still get these weak signals. Please explain this.

Answer: Inasmuch as several of our readers are asking about this circuit, I am printing in Figure 6 the correct connections for the addition of a one-step radio frequency amplifier together with a step of audio frequency which should give very good results if connected as shown. The humming sound you speak of is called a beat note, and is caused by the radio frequency tube oscillating, rectifying the signal instead of amplifying it. Probably the reason you can hear signals without the RF stage working is due to the fact that this part of the circuit acts as a condenser and passes the signal on to the detector without actual contact.

A. S., Chicago, Ill.

Question: I have a crystal set made up as per enclosed drawing received from you, and have had very good success with it. However, since change in wavelengths, I have been unable to pick up KYW station, which before the change came in loudest of all. Can you suggest any change in this set to enable me to again receive this station?

Answer: I am mailing you a diagram with suggested additions and changes, which I trust will enable you to again receive this station as you did before.

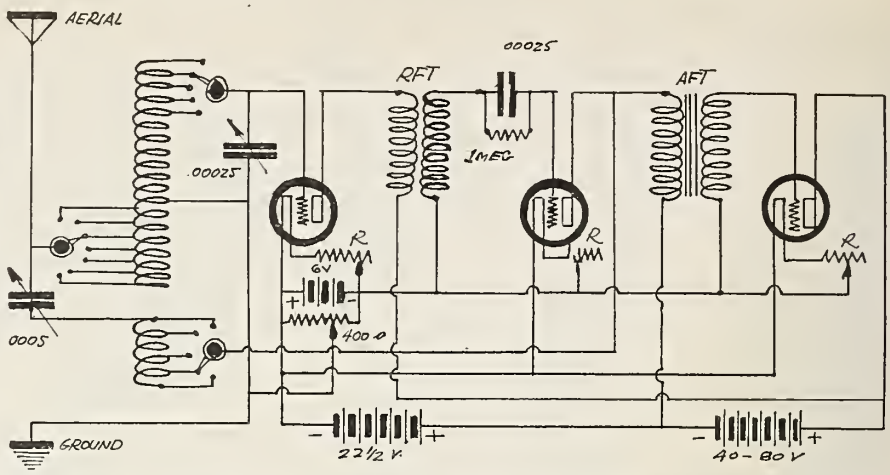


Figure 6. Many of our readers are contemplating the addition of radio frequency to their Reinartz sets. This circuit shows about the most efficient arrangement yet found.

Would advise that you carefully note the time at which this station is transmitting, as the change in wave length has affected the transmitting of this station very much with regard to range and signal strength. Improvements are being made and it will shortly become normal. You will have to tune lower than before, as their wave is now around 347 meters.

W. R. B., Odenton, Md.

Question: I recently purchased a wireless specialty receiver from the Navy Department but it has proven unsatisfactory and so I want to change the hookup. The apparatus is connected as enclosed drawing shows. Provision is made for both crystal and tube detector. What changes will be necessary to make this set efficient?

Answer: Your drawing shows a 43-plate condenser across the secondary of the variocoupler which is incorrect. Substitute a 23-plate in its place. It may be that this set was designed for use on waves of from 600 meters and up. This would be detrimental for tuning short waves. Investigate and see if the coils used for primary, secondary and tickler have more than 75 turns for primary and secondary and if the tickler has more than 100 turns. If it has it may be necessary to remove about 25 turns from each one of them. The July issue contains the hookup you should use for the tube set, in the questions and answers section.

Mexican Fair

The recent radio fair, held in Mexico City, aroused considerable interest, and there has been an increase in sales of radio telephone apparatus. Some low-priced German equipment is now coming on the market, the Department of Commerce has been advised.

Remote Control Broadcasting

(*Continued from page 10.*)

music. This system also enables KYW to give a complete broadcasting service to millions of radio listeners in the United States and its neighboring territory.

Boulevard Concerts

Le Matin, the well-known Parisian daily, is operating a concert radio receiving set in front of its office on a popular boulevard, where crowds gather to listen to news, concerts and statistics from fourteen amplifying horns. The amplifiers are sufficiently loud to be heard over the terriffic traffic noises, Consul Ives reports from Paris.

The public listening-in station was installed by the Societé Francais Radio Electrique which broadcasts two concerts daily on 1,780 meters. Other broadcasting is done by the Eiffel Tower on 2,600 meters, and the Superior School of the telegraph and telephone service of the government on 450 meters.

No provision for a royalty to broadcasters has been made in France, beyond the payment of an annual fee of ten francs to the French Postal Service by owners of wireless receiving sets. The Eiffel Tower radiations are sent out for the general public, and the Superior School broadcasts are carried on in the interest of education and experimentation. The Societé Francais Radio Electrique, however, states that it obtains its remuneration by the sale of the "Radiola" receiving sets adapted to the broadcasting system used by the Societé. explaining that in order to receive its wireless concerts properly it is essential that a "Radiola" set be used. The assertions of the company are corroborated by private set owners who say that other receiving sets are unsuitable for the company's broadcasts, concerts being heard very indistinctly with other sets, if at all.

Listening-in is becoming popular in France, it is reported, although not as extensively as in the United States. Anyone may own a receiving set there, but transmitting outfits must be licensed by the government. French receiving sets are advertised for sale as low as 250 francs each. No specific import duties are prescribed for complete radio receiving sets, but the different parts are dutiable separately.

Most of the French broadcasts are on long wave lengths, except those of the Superior School.

Little Things That Help

Polarity Indicator

A simple polarity indicator can be constructed by taking two pieces of copper wire which are not insulated, and inserting them into a diluted solution of sulphuric acid and water. If the acid is not handy the plain water will often serve the purpose. The two wires are placed in the solution and are connected to the source of potential to be tested. As the current flows through the wires and solution, there will be noted small bubbles of gas rising from the wires. This indicates the decomposition of water into hydrogen and oxygen. Water being composed of these two gases separates into their respective values, of hydrogen two parts and oxygen one. It will be noticed that one of the

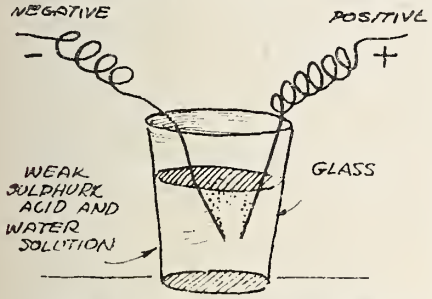


Figure 1. This arrangement is probably the simplest method of finding polarities of batteries, currents, etc.

wires gives more bubbles than the other. THE HYDROGEN IS THE NEGATIVE POLE OF THE SOURCE AND THE OXYGEN THE POSITIVE. Or saying it in a different way, the wire giving the most bubbles is the negative and the lesser of the two is the positive. Try it on your B battery.

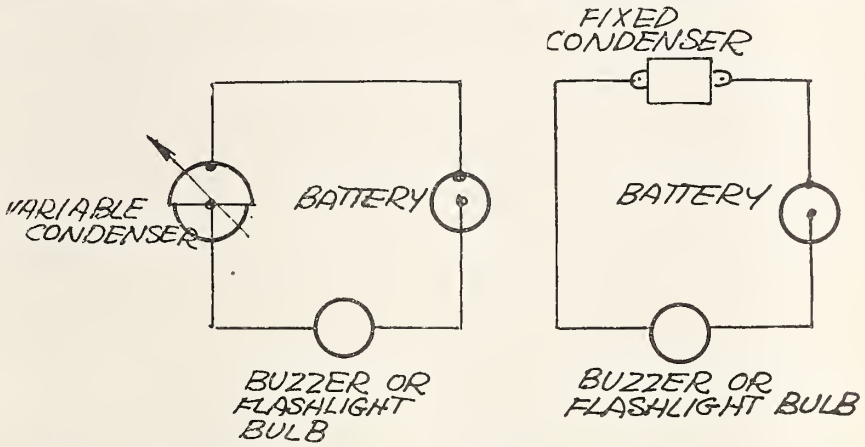


Figure 2. Our crystal set users will welcome this suggestion for testing out their crystals. The connection on the buzzer should run to the ground post on the receiving set.

Simple Test for Condenser Short Circuits

Procure a dry cell and an ordinary flashlight battery and touch it to the terminals of the fixed condenser, as in figure 2. If the condenser is defective, the bulb will light. This applies to fixed condensers and variable condensers as well. To test a variable condenser, the connection is made to the rotary and stationery plates respectively. The plates are then turned, and the bulb is watched. If the condenser plates touch or are shorted, the bulb will light indicating faulty spacing.

This test is essential where the condenser is to be shunted across the B battery and filament as in the Grimes circuit, or where a large capacity condenser is connected across the B battery. If a phone condenser is defective it will short circuit your phones and you will hear no signal.

If you are having trouble with noises in your set which can be varied when the condenser is turned or if the phones give a rasping noise, it might be a good idea to apply this test.

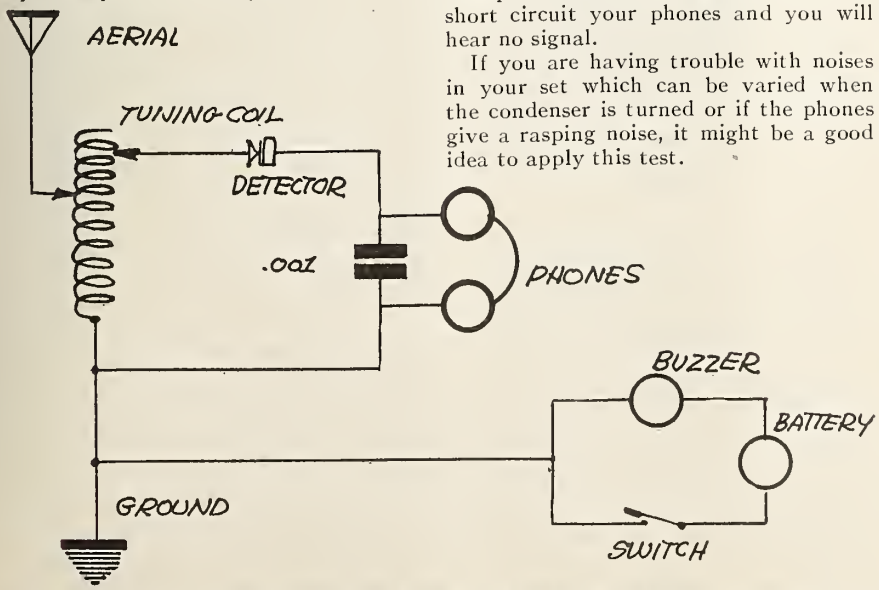


Figure 3. If you are having trouble with scraping, rasping noises in your set, which are amplified by turning the condenser knob, try this test on them. It can also be used for testing breaks in coils, and for loose connections.

Testing Crystals

An easy and well-known method for testing crystals is possible by the simple use of an ordinary buzzer, a dry cell and a switch. The instruments are connected as in Figure 3, and are used to find the "hot spot" on crystals.

The buzzer is connected to the dry cell and switch in series, and the switch is closed. The buzzer sets up a series of oscillations, which if the detector is properly adjusted will be heard in the phones.

This will dispel all doubt as to whether the crystal you are using is sensitive or not.

New Trouble Finding Chart

A very clever idea for clearing up various troubles in the radio receiving set, is the new Trouble Finding Chart, produced and copyrighted by the Benson Melody Company, 190 North State Street, Chicago, Ill.

This chart has all the troubles known to radio sets listed on one side, and their causes listed on the other. A series of lines extending from each particular case of trouble mentioned, ends in the explanation of what will cause that certain trouble, making it possible for the beginner to solve his own trouble problems without the advice of an expert.

This fills a long felt want in the radio field, as it covers anything which may happen in the set and it is bound to be very popular, not only with the beginners, but also with the fan who has advanced to the expert stage.

NOTICE

Notice is hereby given to all whom it may concern that John Doll, formerly employed in the circulation department of Radio Age, is no longer associated with the publication.

Power Wires in Telephony

(Continued from page 11.)

This feature of the high frequency telephone system gives it a marked advantage for load dispatching over the conventional wire circuit telephone system.

Communication between Jackson and Battle Creek has demonstrated that even lightning storms, which will interrupt service momentarily on the transmission lines, have no effect upon communication by high frequency telephony.

When the system is extended all the outlying sub-stations will use the same transmitting and receiving frequencies or wave lengths as Battle Creek. That is, the dispatcher will be able to talk with any station merely by dialing the proper call number on his desk phone. Under this arrangement outlying stations would not be able, under normal conditions, to talk with each other, but by going a step farther in working out the intricate system of relays and wave-changing switches, any sub-station operator, by dialing the number ten on his phone will automatically cut in a spare set of tuning condensors for receiving and change his transmitting wave length so that, in action, his set then will operate just the same as the load dispatcher's set in Jackson and he can talk with any or all other stations. Another detail of the installation is the arrangement of extra selectors at the various substations through which the dispatcher, by dialing a general call number on his telephone, will ring all substations on the system and be able to transmit emergency orders simultaneously to all substation operators.

The high frequency apparatus, or the radio units of the system, are located at the various terminal stations. Two antenna wires are strung for a short distance on the towers which support high tension power lines. One of these is a sending antenna and one used exclusively for receiving. The antenna wire is given about twelve feet clearance from the power line wire. The upper or transmitting antenna is connected to the transmitting set and the lower antenna to the receiving set.

High frequency currents are generated by a 250 watt vacuum tube similar to those used in broadcasting stations. This tube operates on 2,000 volt direct current. This high frequency current flows into the transmitting antenna and instead of being broadcast through the air, it induces, by electrostatic and electro magnetic induction, corresponding high frequency current in the adjacent power line and this high frequency energy, superimposed upon the energy transmitted normally by the power line, is carried on the power line to the receiving station where, by induction, it is led into the receiving set through the receiving antenna. This unit is an ordinary long wave, coupled circuit radio receiver. It is equipped with a detector and one-step amplifier.

The high frequency currents generated by the 250 watt vacuum tube type oscillator are modulated by a second 250 watt vacuum tube to the grid of which the voice frequencies developed by the microphone are applied. A 50 watt vacuum tube is interposed between the relatively weak microphone circuit and the grid of the 250 watt modulator tube for the purpose of amplifying the voice frequencies.

The largest broadcasting radio stations, such as WWJ, the Detroit News, that has been heard over a radius of thousands of miles, use transmitting sets of 500 watts capacity. Some idea of the energy required to operate the Consumers' Power Company high frequency telephone system may be gleaned from the fact that its transmitters have a capacity of 250 watts, just half the size of WWJ and larger than many of the other important broadcasting sets with which Michigan amateurs are familiar.

Radio Drama

A turn of the dial gains you admission to the radio drama. Tune your radio set to station WGY and at least one evening a week you will hear an entire play, sometimes a comedy drama, a farce or melodrama.

For nearly a year now the General Electric Company station at Schenectady, N. Y., has been offering dramas by radio one night a week and during that period the little group of actors making up the WGY players has had the largest audiences ever before accorded dramatic offerings. Just how large that audience is is difficult to estimate. There are at least 2,000,000 radio sets in the country and of that number 1,500,000 are almost nightly within range of WGY. Many of these sets have loud speakers or extra phones enabling groups to listen-in. The number of people who have heard the WGY players in the continuous run of forty-three weeks is anybody's guess.

Edward H. Smith and a half dozen actors were engaged, about a year ago, to produce Eugene Walter's play, "The Wolf," at WGY. It was something entirely new; it was contended by many that the radio audience would be unable to follow the play with any degree of interest because of the absence of scenery and because they could not see the players. Voice alone, it was contended, would not be sufficient to put over dramatic climaxes.

From the very first the radio drama was a success. Letters veritably poured into the station, asking for more. Mr. Smith, formerly an actor and director on the professional stage, was engaged to produce one show a week.

This work was undertaken in a serious and thorough manner and for months many of the greatest successes of the stage have been going into the air, reaching untold thousands who, but for radio, would never have had an opportunity of hearing the plays. During the past winter when farmers in many parts of the country were snowed in, cut off from the mails, the village, and in many cases their nearest neighbors, radio programs went out to relieve their loneliness. The farmer, the woodsman, the keeper of the lighthouse along the Atlantic coast, were enthusiastic in expressing their appreciation of the dramas.

Mr. Smith and his players have pioneered in the art of the radio drama; they have had to develop a new technic. It was found necessary to make occasional changes in play manuscripts, especially where a climax depended upon sight for its appreciation. The entrance to or departure from a room by one of the characters had to be indicated by sound, as a closing door. A bell helps somewhat in announcing a newcomer to the invisible stage. Various sound devices were created to produce atmosphere. A telegraph key and an imitation of an engine whistle helped in a railway station scene; storms were simulated by devices similar to those used on the stage.

The performer was greatly handicapped at first because he had depended a great deal upon the presence of his audience. Facial expressions were no help to interpretation; strong emotion could be conveyed only by vocal tone. To help the performer to a realization that his work was heard and appreciated WGY requested the radio audience to write their "applause" and this they have done by the thousands. The actor finds inspiration for his work in applause, not of hands clapping, but in written words.

A Broadcast Freak

With nearly 600 radio broadcasting stations in the air, many of them at the same time, it is not unusual for an operator to pick up two or three stations at the same time. Then begins the delicate task of tuning out all but the desired station, a task frequently impossible and always trying to the temper.

It is most unusual, however, for a fan to secure dual reception and discover that both stations are playing the same tune in the same key and tempo.

This occurred Tuesday evening, May 22, at 8:21 o'clock. A Providence, R. I., radio fan recently wrote WGY, the Schenectady station of the General Electric Company, that he had heard the Radio Four sing "Dixie" from WGY at the same time that WEAN, the station of the Shepard Company in Providence, was sending out a phonograph record of "Dixie," a banjo solo with piano accompaniment. Part of the letter follows:

"Just once you faded out and WEAN was playing a banjo solo with piano accompaniment, 'Way Down South in Dixie.' What was our surprise to hear your minstrels come in on the same song, in the same key and same tempo and together the two companies, so many miles apart, finished the verse and chorus."

The log of WGY showed that the Radio Four had sung "Dixie" on the night and at the time given by the correspondent and R. F. Shepard, Vice President of the Shepard Company has reported that his station broadcasted the same number at that time.

Factors That Have Made Radio Broadcasting Possible

By S. M. KINTNER
Manager Research Division, Westinghouse Electric & Manufacturing Company

IN THE early days of radio, more than 20 years ago when it was called wireless, there was a man in Pittsburgh working on the development of an idea which, when it was perfected, completely revolutionized the art.

The Marconi system, the one then in use, was founded upon a device termed a coherer, which was generally acclaimed as the most marvelously senstitive mechanism ever conceived by man. It was generally said, and by those best qualified to speak, to be *the essential* element which made the "wireless telegraph" possible. Yet in the face of all of this praise of the coherer, the so-called "*electric eye*," this Pittsburgh man clung to his idea which called for no less radical a move than the complete abandonment of this so-called indispensible part.

The coherer was a trigger device which was tripped by the received signals and required resetting before it could operate again.

This resetting required time and limited the rate at which messages could be received. It had another defect more serious than its slowness, in that all signals sounded alike.

A signal from a nearby station was no louder than from one much more distant. With such a device radio telephony was unthinkable. In fact, I have recently been told by the man who was then the examiner of wireless inventions in the United States Patent Office that he had told his friends that "no one would ever be able to telephone by wireless methods."

The Pittsburgh man set himself the task of making a radio receiver which was constantly in condition to receive and which gave a response in proportion to the amount of the received energy.

He succeeded in producing several such devices all capable of meeting his requirements. We then noticed that he could distinguish different transmitting stations by slight difference in their spark sounds. With his detector he used telephone receivers to make manifest the received signals, whereas the Marconi system employed telegraph sounders.

This observation suggested that there was some constant difference in the radiation of one station from another that gave it character and made it distinguishable like the voice of a particular individual.

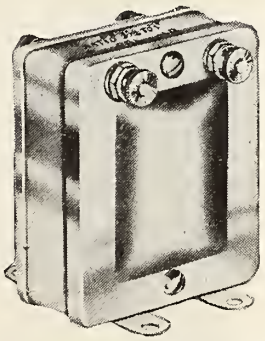
If then the radiation could transmit such characteristic spark tones, all waves being developed by spark discharge at that time, why was it not possible to transmit any tone if only the way of controlling the radiation could be determined?

The Pittsburgh man to whom this experience relates was not long in devising a simple way of proving his theory. He simply placed an ordinary telephone microphone in the antenna of his transmitting station, which was arranged to give several thousand sparks per second, and while his assistant talked into the microphone, R. A. Fessenden, the Pittsburgh man, listened at his receiver and heard the first words ever transmitted by radio telephone.

Pittsburgh, then, is the birthplace of radio telephony, both as to the instrumentalities and the application in this newest and greatest field in which it has been employed, broadcasting. To R. A. Fessenden, then a professor in the University of Pittsburgh, came the idea which revolutionized the radio art and led directly to his invention of the radio telephone: to H. P. Davis, Vice President of the Westinghouse Co., came the vision of broadcasting which led to the creation of KDKA and the many others following it.

Pittsburgh is justly proud of her record of accomplishments in radio but those responsible for the accomplishments realize that still more is needed to place radio broadcasting on a plane where it will render the service of which it is capable.

The channel of Communication that carries voice consists of electromagnetic waves, which can be thought of as like water waves in shape and exist in what is termed the ether. The ether, scientists tell us, permeates all space and is the means, by wave motion again, by



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which the light from the distant stars is brought to the earth. Light waves and electro-magnetic waves used in radio are alike aside from their length. They both travel outward from an exciting source at the same speed, 186,000 miles per second, almost 7½ times around the earth in a second of time. Every second of time more than 800,000 waves leave the radio antenna and rush outwards with their inconceivable speed. They rush past the receiving antenna and in so doing give up a small part of their energy, which manifests itself as a minute electric current which surges to and fro in step with the onrushing waves. If the antenna is properly in tune the currents set up will be much larger than if it is not. This difference may have a ratio of the order of 100 to 1. If the receiving antenna is located very near to a transmitting station the strength of the "out of tune" currents may be sufficient to be distinctly heard. This accounts for the interference that is sometimes caused.

To return for a moment to the transmitting station which can be pictured as a continuous emitter of waves, and see how those waves are modified to convey the sounds it is desired to transmit, let us take a single tone—high C—of the soprano. That tone is made by 1,024 vibrations per second in the air. If then the intensity of the antenna radiation is varied 1,024 times per second and caused to change from a maximum to a minimum at a regular rate, the current in the receiving antenna will also vary in a corresponding manner, when this received current is passed through the necessary appliances and finally gives its indication in the telephone receiver, 1,024 vibrations of the diaphragm results and the tone high C is reproduced. What is true of one tone is equally true of others and of combinations of others and in this manner a voice controls the rate of energy emission from the station by varying the intensity of the waves, and the waves, without changing in the number per second sent out, are delivering the message.

The oscillating currents set up in the receiving antenna cannot be applied directly to the telephone for they are of too high a frequency to give any response. Remember the sound frequency is conveyed by the *variation* of the radiated *wave intensity* at the sound frequency. For convenience the radio art has adopted the terms radio frequency and audio frequency as terms indicating certain ranges of current or wave frequencies. An audio frequency is one within the audible limit, which, for most ears, is below 15,000 complete oscillations per second. Radio frequencies are all frequencies above the audible limit. All radio waves used in transmitting, excepting a very few from some of the transoceanic high powered radio telegraph stations are of radio frequency.

Remembering now that the currents set up in the receiving antenna have the same frequency as that of the waves producing them and that they are of radio frequency, that is, above the audible limit, it is apparent that something must be done to convert them to a usable form, before applying to the telephone receiver. This change is made by what is termed the detector. This device, a crystal or a tube, permits currents to pass in one direction but not in the other. By collecting all of the current pulses that pass and storing them in a condenser, from which they are drawn by the telephone receiver, it becomes possible to detect the variation in the rate of energy arrival. That is the swelling and shrinking in intensity of the radiated waves, as produced by the sound waves being transmitted, causes a corresponding swelling and shrinking of the charge in the condenser, and of the current in the telephone receiver withdrawing it, and gives a reproduction of the originating sound.

That is the essential idea of radio telephony. The important elements needed to practice it, which we now look upon as essential, will give way, as the art develops, to improved appliances and methods, just as Marconi's coherer and system was abandoned for the Fessenden form of detector and system of operation, the one now being used.

Service in Denmark

Radiotelephone connection between Copenhagen and the island of Bornholm in the Baltic Sea, heretofore poorly equipped with means of communication, is now an accomplished fact, Trade Commissioner Sorensen reports. Radiotelephony between the two points is now open to the public. The radio circuit, which consists of the four stations: Amager, Lyngby, Hammeren and Ronne Radio, is based on the Poulsenarc system, manufactured by the German firm, Lorenz. The installation permits of communications in either direction simultaneously. The radio is connected with the ordinary Copenhagen telephone system, so that any subscriber may ask for a number on Bornholm Island and get connection. The cost for a call is 3.50 crowns for a three-minute period.

Helps Amateurs

Washington, D. C.—The Department of Commerce has authorized a broader band of wave-lengths for general and restricted amateur radio stations, and created a new class of amateur operator's license to be known as" Amateur Extra-First-class."

The new regulations sent to all district supervisors of radio provide that licenses will be issued permitting the use of any type of transmitter—CW, Spark, AC-CW, ICW, unfiltered CW and phone—with the restriction that when using pure CW they are authorized to use wave lengths from 150 to 200 meters and when using spark, AC-CW, ICW, unfiltered CW and phone the wave lengths from 176 to 200 meters only can be used. The types of transmitters must be specified in the application and the license.

Special amateur radio station licenses will be issued permitting the use of pure continuous wave transmitters only, authorizing the use of wave lengths from 150 to 220 meters.

For the purpose of application to amateur stations, pure CW is defined as follows: A system of telegraphing by continuous oscillations in which the power supply is substantially direct current as obtained from (1.) a generator, (2.) a battery, or (3.) a rectifier with an adequate filter. A filter is not deemed adequate if the supply modulation exceeds five per cent.

General restricted and special amateur stations are not permitted to use a transformer input exceeding one kilowatt, or equivalent of this power based upon watt input to plates if tubes are used. Where input rating of tube is not specified by manufacturer this rating will be considered as double the manufacturers output rating.

On licenses issued for amateur stations you will include the following: "This station is not licensed to transmit between the hours of 8 and 10:30 p. m., local standard time, nor Sunday mornings during local church services."

Special amateur stations must be operated by persons holding an extra first grade amateur operator's license, or a commercial first-class operator's license, or a commercial extra first-class operator's license. Applicants must also meet the requirements of Regula-t.ons 63.

A new class of amateur operator's license is hereby established to be known as "Amateur Extra First Grade." Licenses of this grade will be issued to persons passing the required special examination with percentage of at least seventy-five and code speed in sending and receiving at least twenty words a minute, five characters to the word; who have had at least two years' experience as a licensed radio operator; and who have not been penalized for violation of the radio laws subsequent to the date of these regulations.

The chains of habit are too weak to be felt until they are too strong to be broken.

Naval Radio Service Increases Efficiency

(By Washington Radio News Service)

Washington, June 11.—The Naval Communication Service in the past three months has made gigantic strides in the efficiency of its service, chiefly through educating its untrained personnel. Courses of radio instruction, in addition to the regular schools at Great Lakes, Norfolk and San Francisco, have been prepared and the results are "very gratifying," a recent report states. Today the 1200 radio men stationed ashore are receiving intensive training in fleet communication, so that they will be familiar with sea operation. Today the personnel of the Communication Service of the Navy is in better shape than in any other branch of the service, officers of the Communications Service state.

A survey of the radio personnel situation just completed by the Navy, shows that there are 2443 radio men on duty, and that vacancies in the three higher rates exist. Following examinations held in May, 170 radio men were promoted to higher rates, fifteen of them becoming Chief Radiomen. There was still a shortage of 562 men in the service.

Opportunities in the Naval Service are good for young men, communication experts point out, citing a recent case where a young man of 20, who held the rate of First Class Radioman, was persuaded to remain in the service, because at 32 he would be eligible for transfer to the Reserve with a regular income of $75 to $80 a month. No such an opportunity awaited a young man in ordinary business pursuits, it was explained. This young man is now enroute to sea duty in the Mediterranean.

Service Improves.

Discrepancies in transmission of messages by the Navy has been decreased markedly during the past six months. During a recent period of supervision, five Atlantic stations had no errors, while the only two out of the other seven had over one tenth of a word in a thousand wrong. Manipulation has improved greatly, operators are better instructed in precedure and are most attentive, the report states.

In an effort to decrease governmental radio interference, a special committee composed of members of the Interdepartmental Advisory Committee on Radio, has made a study of wave frequencies used by the Government and recommended certain changes to the Department of Commerce. In view of this, Secretary Denby of the Navy has requested that a complete survey of all Government radio activities be now undertaken by this committee, so that complete cooperation and co-ordination may be had.

Commander S. C. Hooper, in charge of Radio Engineering in the Navy, it is reported, will become Fleet Radio Officer under Admiral Coontz, when the latter assumes command of the U. F. Fleet early in August.

Wartime Radio

As an instance of the work of former amateurs, who served in the Signal Corps during the war, it is said that seventy-three per cent of the 400 radio men engaged in intelligence work were ex-amateurs. Not a single "leak" occurred in the service, which intercepted 73,000 enemy messages and recorded 175,000 bearings on enemy radio stations. The country and the Signal Corps is greatly indebted to these amateurs for their war work.

Although little was known of the work of the radio intelligence section of the army during or since the war, it was one of the most spectacular. Radio direction finders were placed all along the lines, at a distance of about five miles from the actual front and spaced about twelve miles apart. These receiving sets located the enemy stations in operation, recorded their bearings by means of directional coils, not unlike modern radio compasses, and forwarded the bearings to headquarters where they were plotted on maps. The reports from any American radio observers enabled the staff to keep an accurate check on practically all the German stations all the time.

Other radio receiving stations at army headquarters, intercepted and copied all enemy code messages, and telegraphed them back to general headquarters where code experts worked them out, giving the staff valuable information as the movements or intentions of the enemy.

On one occasion, when the Germans were planning a big offensive, the code all along the line was suddenly changed. The old code, known by the Americans for some time became valueless. But one German officer could not decipher a long message sent him in the new code and asked his commander to repeat it in the old one. This was done and as the American intercepting stations copied both messages, the staff of experts at headquarters soon had a fair solution of the new code, which they eventually worked out in its entirety. The repetition of the message in both codes was more than they hoped for, and when the new code was transmitted to the French and British headquarters, the American radio intelligence service was credited with a big "scoop."

Many times, it is recorded, enemy messages were intercepted, decoded, and rushed to the troops at a threatened front in time for them to prepare for the projected attack.

Wonderful results were also accomplished by our advance listening-in stations in front line dugouts and trenches, with amplifiers, the wires radiating to grounds in no-man's land. Sometimes they were actually tied in on enemy phone lines. These stations picked up enemy phone conversations by induction, enabling our operatiors to copy orders and messages.

Few things are impractical in themselves; and it is for want of application, rather than means, that men fail of success.—[Rochefoucauld.

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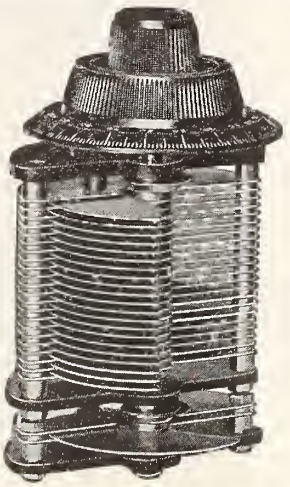

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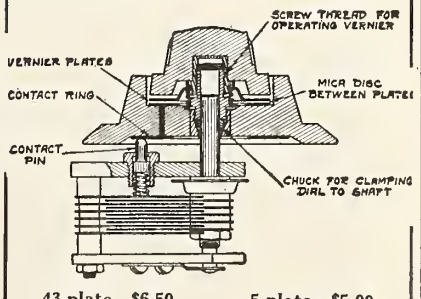

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500 N. Dearborn Street **Chicago, Ill.**

Radio Camping

By VELMA CARSON

Westinghouse Electric & Manufacturing Company

It takes one more paddle to go canoeing nowadays than it used to. Besides the one for propelling the boat there must be a paddle for catching concerts.

And besides a girl, some cushions, a camera, and a lunchbasket the young man takes along a small radio receiving set. They come now in small boxes with a handle and are as easy to carry as any of the aforementioned prerequisites to the successful canoe trip.

He puts the set between himself and the girl in the bottom of the boat, places the extra paddle perpendicularly against the back of the seat and has her lean on it to hold it secure. Then he attaches one wire to the upright end of it for an aerial and trails the other wire in the water to ground his circuit. They put on the head phones. He tunes in to the nearest station and paddles off to the shadiest nook he can find.

Imagine this canoe on a moonlight night away off down the river and an unseen orchestra playing, "Melody of Love!"

If there is any time in the world that a person is in the mood for good music it is at the end of a long, thrilling day exploring in the woods or doing any of the relaxing things that are a part of camp life.

Even the rattly-bang piano player with a one-sided repertoire, or the banjo picker who knows eight old songs, or the sixteen-year-old with a thin voice and ukelele have always been welcome in a summer camp. Well, if the man who can improvise on a mouth organ has had his share of appreciation out in the woods, the radio, with its diverse programs, is sure to be listed right along with the iron skillet when the question comes up concerning camping paraphernalia.

The business man who wants to hide himself from business annoyances, the telephone, newspapers, and other people can still get the news of the day and satisfy his curiosity about the baseball scores.

If mother does not care about too much strenuous hiking and swimming she can be sure of having entertainment while she rests in camp. The children can be kept occupied at the awful hour of bedtime, and the young people can have dance music without the trouble of importing a victrola or a piano. Besides if one is to go into wilds sufficiently wild these cumbersome instruments are practically impossible.

One group of Camp Fire Girls learned the joy of doing interpretative dancing in their bare feet on grassy slopes near their camp in the North woods by radio last summer. They also studied the art of telling stories from the "Dreamtime Lady."

It is no small help in any camp to get the weather report and river conditions.

"Humoresque" goes beautifully with bacon and eggs and does not detract in the least from the chirp of crickets.

In Czechoslovakia

The manufacture, sale, storage, and importation of radio telephone and telegraph equipment in Czechoslovakia is only permitted under license from the state, says Trade Commissioner H. L. Groves in a report to the Department of Commerce. The Ministry of Commerce in cooperation with the Ministry of Posts and Telegraphs are authorized to grant licenses for this purpose. The Ministry of Posts and Telegraphs also supervises and controls the manufacture, sale and storage of radio equipment and cooperates with the Ministry of Commerce in the granting of licenses.

Up to the present time only one company, "Radioslavia," has obtained a license for the manufacture of radio equipment in Czechoslovakia. It has not yet started production. This company is understood to be affiliated or closely connected with the French Company "Societe Francaize Radio-electrique." A German Company—"Gesellschaft fur Drahtlose Telegraphie, System Telefunken"—is said to be promoting a company with Czechoslovak capital for the purpose of exploiting German wireless patents, but it has not yet been granted the necessary license.

The attitude of the Ministry of Posts and Telegraphs toward the granting of licenses to transmit as well as to receive radio messages is said to be favorable in the following instances:

(1) Technical High-schools, for scientific purposes.

(2) Industrial establishments which have obtained special licenses from the Ministry of Commerce to manufacture radio equipment.

(3) Ships and aircraft.

(4) Electric power stations, waterworks, and other establishments of public utility, under special conditions.

(5) Companies which have been authorized by the state to broadcast matter of general interest, such as news-statements, exchange reports, agricultural reports, concerts, lectures, etc.

Licenses for the operation of receiving sets only will be granted to institutions, companies, and those regularly taking the reports transmitted either by the State Telegraph Office or by companies authorized by the state to transmit such messages.

Random Reports

Recent reports from the Navy Department indicate a very considerable amount of interference from mush and harmonics at all points within 200 miles of Pearl Harbor. Current transformer circuits will be installed on the Honolulu transmitters of the navy within the near future, which will eliminate this interference it is hoped.

Naval experts admit that arcs and spark transmitters create a considerable amount of interference in their vicinity, unless special circuits are installed to reduce such interference. Transmitters of these types are being modified as rapidly as funds permit. On arc transmitters current transformer or similar circuits are being installed and spark transmitters are being replaced by tubes.

New RCA Official

F. P. Guthrie, until recently head of the radio division of the Shipping Board, has been appointed district manager for the Radio Corporation, with headquarters in Washington, D. C. Mr. Guthrie has followed radio for years. During the war he served as a commissioned officer in the Naval Communication service. It is understood that he will have charge of the corporation's new broadcasting station, soon to be opened in Washington, as well as the commercial work.

A. H. Morton, who has been in charge of the corporation's commercial station here for some time, has been transferred to New York, where he will take up organization duties in that district.

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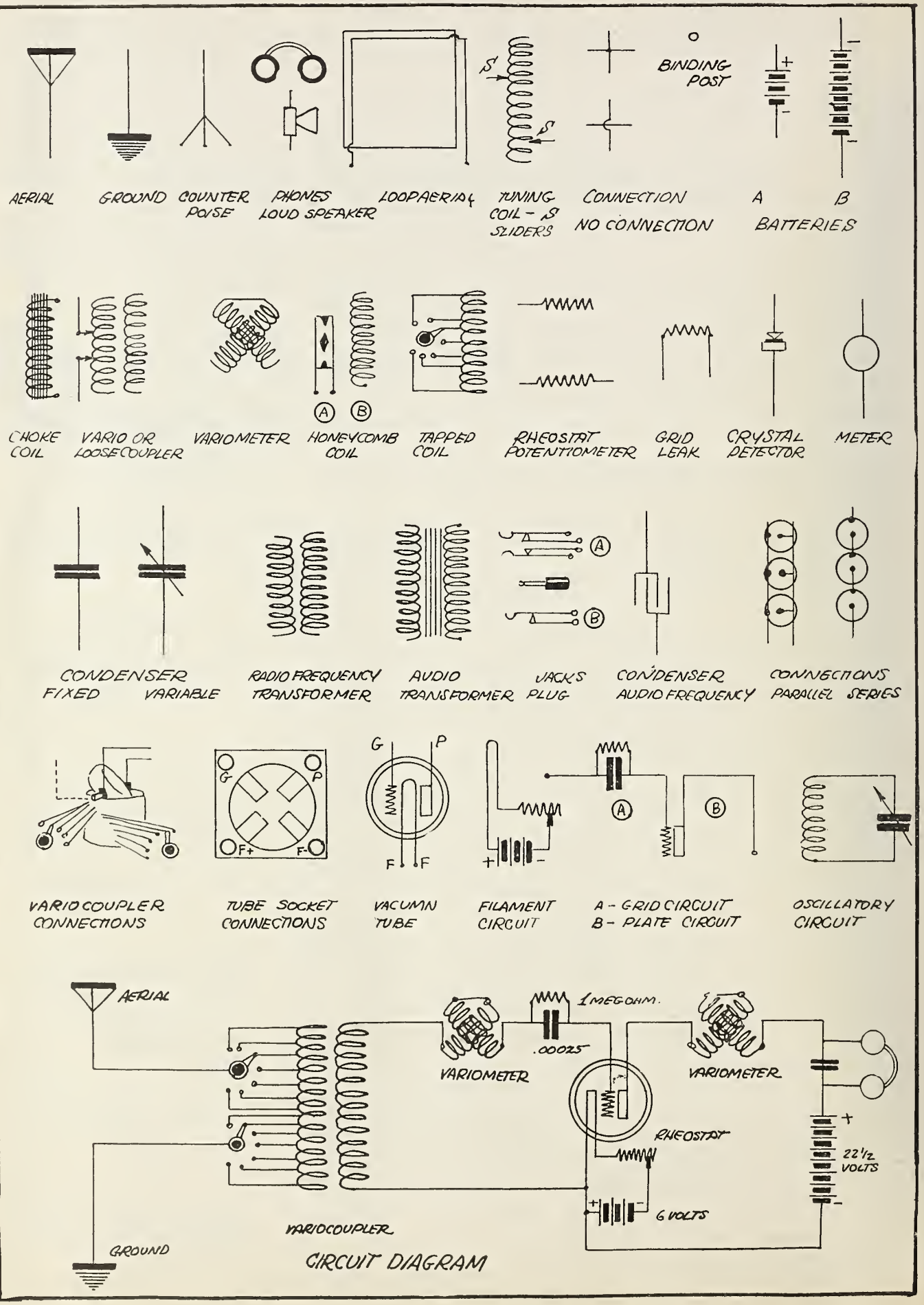
AERIAL
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LOOP AERIAL
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CONNECTION
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BINDING POST
A BATTERIES
B
CHOKE COIL
VARIO OR LOOSE COUPLER
VARIOMETER
HONEYCOMB COIL
TAPPED COIL
RHEOSTAT POTENTIOMETER
GRID LEAK
CRYSTAL DETECTOR
METER
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VARIO COUPLER CONNECTIONS
TUBE SOCKET CONNECTIONS
VACUMN TUBE
FILAMENT CIRCUIT
A - GRID CIRCUIT
B - PLATE CIRCUIT
OSCILLATORY CIRCUIT
AERIAL
1 MEGOHM.
.00025
VARIOMETER
VARIOMETER
RHEOSTAT
22 1/2 VOLTS
6 VOLTS
VARIOCOUPLER
GROUND
CIRCUIT DIAGRAM

Inter-American Communication Conference Proposed

An official resumé of the activities of the Fifth International Conference of American States, held at Santiago, Chile recently, cites the recommendation for an Inter-American Electrical Communication Commission and a communications conference.

"Inter-American Electrical Communication: The first part of this resolution recommends to the American States, as an essential part of the public service, the supervision of international electrical communication and also domestic electrical communication insofar as it affects or forms part of the system of international communication. As a part of this resolution provision is made for the establishment of an Inter-American Electrical Communications Commission to consider the cooperation which may be established between the American States regarding electrical communications, and to prepare a convention which shall establish equitable proportional rates and uniformity of rules governing Inter-American Electrical Communications; this commission to be called at a place and date to be determined by the Governing Board of the Pan American Union. The conclusions of this Commission shall be submitted to the Governing Board of the Pan American Union in order that they may in turn be submitted to the States belonging to the Pan American Union."

Short Waves in Beam

F. W. Dunmore and F. H. Engel, radio experts of the Bureau of Standards, state that for point-to-point radio communication, there are two important ways of reducing interference; that is, to direct the waves radiated from the transmitting stations in a narrow beam toward the receiving station, and to use short wave lengths which are not at present employed.

Experiments have recently been conducted at the Bureau of Standards on transmitting apparatus, employing electron tubes, which transmits a directed beam of radio waves, and employs waves as short as ten meters. This system offers substantial relief from interference difficulties, and also has the military applications. The apparatus has been used for communication by both radiotelegraphy and radiotelephony.

In the experiments, a reflector was used, consisting of short parallel vertical wires, arranged on a frame shaped like a parabola, This reflector acts much as an ordinary mirror would for light waves. The radio waves are, in fact, the same kind of waves as light waves, but of considerably longer length. Forty vertical wires were used and the generating set with its small antenna was placed at the focus of the parabola. Each wire was tuned separately to ten meters by adjusting its length. It was found that about seventy-five per cent of the radiated energy could be confined within an angle of about seventy-five degrees.

This apparatus is described in Scientific Paper, No. 469, of the Bureau of Standards, entitled, "Directive Radio Transmission on a Wave Length of Ten Meters." Copies may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., for ten cents.

New Station Idea

The Chesapeake and Potomac Telephone Company has given Washington another broadcasting station. It is a class B station with an individual wave length which will reach to all corners of the nation. This company, which is a member of the American Telegraph and Telephone Company, has started the erection of the second of the Bell-system broadcasting stations, and plans to duplicate in power and quality the New York station, WEAF.

A unique feature is that the new plant will be a public service station; that is, it will be operated without profit and may be leased or chartered by other interests for periodic broadcasting at a rate equivalent to the proportional cost of operation.

It is understood that a local broadcasters' association may be organized and the operating time of the station divided to care for its members. This, it is believed, will save small operators considerable money in comparison to the costs of installation and upkeep of private broadcasting stations. Certain hours of any schedule would be reserved by the telephone company for the transmission of matter of public interest, such as presidential addresses, congressional debates and governmental information. Important concerts broadcast from WEAF in New York, may be sent by land line to Washington, and broadcast simultaneously from the new station, officials say.

The electrical equipment is the product of the Western Electric Company, and was installed under the direction of C. & P. and A. T. & T. Co., engineers. The station is located on the telephone building, 725 Thirteenth Street, the towers being erected on the roof.

Send $1.00 to Radio Age, 500 N. Dearborn Street, Chicago, and receive this instructive radio periodical for six months. Regular subscription price is $2.50 a year.

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We want representatives in every community to obtain subscribers for Radio Age. Excellent opportunity for radio enthusiasts to make good money quickly. Write Radio Age, Inc., 64 West Randolph Street, Chicago, Ill.

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If you have not bought your Reinartz Book, fully illustrated with hook-ups and clear description of how to make this popular circuit, send $1.50 in money order or check and we will send you the booklet "Reinartz Radio" and place you on the subscription list of Radio Age for six months. Address Radio Age, 500 N. Dearborn Street, Chicago, Ill.

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Locates Immediately
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190 N. State St., Chicago, Ill.
Manufacturers of Melody Portable and Power Speakers — Radio Distributers
Service Dept. Work at Reasonable Price.

The Newest Radiotron, Model U V-199

By J. C. WARNER
Research Laboratory, General Electric Company

(*Continued from page 8.*)

cell battery will operate a single UV-199 tube one hour per day for a month. This combination makes it possible to build a portable radio set containing a tube detector, complete with batteries and phones, and weighing only five or six pounds.

Another interesting comparison gives an idea of the low filament consumption. We usually think of the power consumed in the plate circuit of a vacuum tube as being very small, and this is quite true, but in some cases, the UV-199 may use more power in the plate circuit than in the filament. For example, the plate current at 80 volts may be 2.5 milliamperes, making a plate power consumption of .2 watt, while the filament power is only .18 watt.

The life of an X-L tungsten filament is usually terminated, not by actual burnout, but by a decrease in electron emission. This decrease is not gradual during the life of the tube, but occurs suddenly, close to the end of life, and is indicated by a marked increase in the voltage required on the filament to give good results.

In spite of the reduction of filament current in the UV-199, the other electrical characteristics of the tube have not been sacrificed in the least. In fact, the UV-199 is a better detector and amplifier than the UV-201. The amplification constant averages 6.25 for the UV-199 compared with 6.0 for the UV-201. The plate impedance at 40 volts is about 18,000 ohms for the UV-199 and 20,000 for the UV-201. These figures, which in themselves are perhaps of little interest to you, simply mean that the UV-199 is a somewhat better amplifier than the UV-201 and in the usual audio frequency amplifier circuit will give nearly 50% more power for the same input voltage.

It is, of course, not to be expected that the UV-199 should give as great power amplification as the UV-201-A. The UV-201-A is a larger tube, having large electrode surfaces and requiring greater filament energy and naturally is capable of supplying large power amplification. However, it does not have the advantage of dry battery operation except in limited cases.

As a detector, the UV-199 functions very well in any of the usual circuits and is particularly well adapted to use in single tube sets where small size and weight are de-

The capacities between the elements of the UV-199 are exceptionally small and for this reason this tube is an excellent radio frequency amplifier and little trouble is experienced with undesired oscillations.

In common with all vacuum tubes and in fact almost any sort of electrical apparatus, to obtain best results it is necessary to observe a few simple precautions. These are described in detail on the instruction sheet furnished with each tube so that it is only necessary to mention a few of them briefly here.

Of first importance perhaps is the injunction to take care that the plate battery does not become connected to the filament by accident. The UV-199 filament requires such a low voltage for normal operation that the twenty to eighty volts of the plate battery will burn it out instantly, and unless one is looking at the tube the burnout may occur so quickly that he does not know what has happened. A ten watt Mazda lamp placed in series with the plate battery will prevent any such accidental burnout.

Instructions as to proper filament, plate and grid voltages are important. Do not forget that if you are operating a single tube from three dry cells, you must have a thirty ohm rheostat in series with the filament, and if you are using a six volt battery you must have about sixty ohms in series. Otherwise, the filament voltage will be excessive and will shorten the life of the tube.

When the tube is used as a radio frequency amplifier or as a detector, the plate voltage should be not more than 45. For audio frequency amplification the plate voltage may be increased to 80, but in this case a grid battery should be used to prevent distortion and also to limit the plate current and so prolong the life of the "B" battery. The correct connections for the detector and amplifier tubes and the location of the grid battery are clearly shown on the instruction sheet. This also shows the arrangement of the contact pins in the base. The arrangement is not the same as in the UV-200, UV-201 and UV-201-A, the change having been made in order to bring the grid and plate terminals on opposite sides of the socket and to make possible very short leads between tubes and transformers.

The UV-199 and UV-201-A are

by the colored or silvered appearance of the bulb. There is often a considerable variation in the amount of coating, but this has no detrimental effect on the action of the tube.

The X-L filament has made possible one other important improvement which appears in both the UV-199 and UV-201-A. This is the almost complete elimination of tube noises. It is true that the term "tube noise" is often used to cover everything from loose connections to howling due to improper circuit adjustments, but true tube noises may be divided into two classes. First, a sort of crackling which resembles some forms of static, and second, a steady hissing or roaring noise. The crackling noise is characteristic of high temperature filaments and is obviously absent in tubes containing X-L filaments. The hissing noise is due to the presence in the tube of traces of gas and since X-L filament tubes utilize an extremely high vacuum, this source of noise is greatly reduced. This high vacuum also serves to maintain uniform operating characteristics throughout the entire life of the tube.

Domestic Phenol

The manufacture of phenol will soon be under way in a plant now being constructed by the Bakelite Corporation.

This enterprise is the direct result of the protection afforded by the new tariff. American consumers have always been dependent upon a foreign source of supply for this commodity and today are paying abnormally high prices due to a general European shortage and an insufficient domestic production. Phenol, an essential ingredient in the manufacture of high explosives, was manufactured in the United States in a large way during the war—the foreign supply being, of course, strictly embargoed by every belligerent country—but since then the industry went out of existence for lack of tariff protection.

The Bakelite Corporation will manufacture a surplus beyond its own needs and to this extent American consumers will be assured of a supply at as moderate prices as conditions will permit, in conformance with the Corporation's announced policy.

Phenol (carbolic acid) is used for the manufacture of synthetic resins, largely used in the radio industry, also for dyes, for pharmaceutical preparations, for disinfectants and many other purposes. It is absolutely essential not only to industry and the public health, but most important of all for the national defense

Complete Corrected List of U. S. and Canadian Broadcasting Stations

Complete Each Issue

THE list of broadcasting stations on these pages is brought up to date each month by additions of new stations and deletion of those which have suspended operation. The list is the product of a vast volume of correspondence and its completeness is due in large measure to the assistance of our special news service in Washington, D. C. Suggestions, corrections and additional data will be welcomed from readers. Broadcasters: Send in your program schedules.

IXAD, Pawtucket, R. I. 1000 miles; Special license experimental; Standard Radio & Electric Co.
KDKA, E. Pittsburg, Pa.; Class B station Westinghouse Elec. & Mfg Co.
KDOW, Steamship America, New York.
KDPM, Cleveland, Ohio; Westinghouse Elec. & Mfg. Co.
KDYL, Salt Lake City, Utah; news music, entertainment, Telegram Publishing Co.
KDYM, San Diego, Cal.; Savoy Theatre; 252 meters 100 watts.
KDYQ, Portland, Ore.; Oregon Inst. Technology.
KDYS, Great Falls, Mont.; Class B, Great Falls Tribune.
KDYW, Phoenix, Arizona; Smith Hughes & Co.
KDYX, Honolulu, T. H; 12:15 to 1:15 p. m., stock reports and weather; 6:30 to 7:30 p. m., music, lectures; Sunday, 11 a. m. to 12:30 p. m., sermons; Honolulu Star-Bulletin, Ltd.
KDZB, Bakersfield, Calif.; Frank E. Seiffert.
KDZE, Seattle, Wash.; Rhodes Co.
KDZF, Los Angeles, Calif.; Automobile Club of Southern California.
KDZI, Wenatchee, Wash.; Electric Supply Co.
KDZK, Reno, Nev. Wednesday 8 to 9 p m; Friday 8 to 9 p m. Musical and news features; Nevada State Journal, Neveda Machinery & Electric Co.
KDZQ, Denver, Colo. Pyle & Nichols, 1247 Broadway.
KDZR, Bellingham, Wesh; 261 meters, 50 watts; Bellingham Pub. Co.
KFAD, Phoenix Ariz.; Class B, McArthur Bros. Mercantile Co.
KFAE, Pullman, Wash.; State College of Washington.
KFAF, Denver, Colorado; George S. Walker, Western Radio Corporetion; musical programs, news items, etc., daily except Tuesday and Sunday, 8 to 9 p m; mountain standard time.
KFAJ, Boulder, Colo.; University of Colorado.
KFAN, Moscow, Idaho; Electric Shop.
KFAP, Butte, Mont.; Standard Pub. Co.
KFAQ, San Jose, Calif.; City of San Jose.
XFAR, Studio Lighting Service Co., Hollywood, California 280 meters, 200 watts.
KFAT, Eugene, Ore. Monday, Wednesday and Saturday 8 to 9 p m Music; Sunday 8:30 to 9:15 Church Services; Pacific Radio Co.
KFAU, Boise, Idaho; Class B, Boise High School.
KFAV, Venice, Calif.; Abbott Kinney Co.
KFAW, Santa Anne, Calif.; Class B, Radio Den.
KFAY, Central Point, Ore.; W. J. Virgin Milling Co.
KFBB, Havre, Mont.; F. A. Buttrey & Co.
KFBC, San Dieго, Calif.; W. K. Azbill.
KFBE, San Louis Obispo, Calif.; R. H. Horn.
KFBG, Tacoma, Wesh.; First Presbyterian Church.
KFBK, Sacramento, Calif., 2,000 miles; daily, 8 to 4 p m and 6 to 6:30 p m; Sunday and Thursday 8 to 9 p m; Kimball-Upson Co. and Sacremento Union.
KFBL, Everett, Wash.; Leese Bros.
KFBU, Thomas, Bishop, N. S., Laramie, Wyo.; 283 meters, 50 watts.
KFCD, Salem, Ore.; F. S. Bartin.
KFCF, Walla Walla, Wash.; Frank A. Mooro.
KFCH, Billings, Mont.; Elec. Service Station.
KFCK, Colorado Springs, Colo.; Colorado Springs Radio Co.
KFCL, Los Angeles, Calif.; Los Angelos Union Stock Yards.
KFCM, Richmond, Calif., Richmond Radio Shop.
KFCQ, Casper, Wyo.; Motor Service Station.
KFCP, Ogden, Utah, Ralph W. Flygare.
KFCY, Houston, Tex., Fred Mahaffey, Jr.
KFCY, Le Mars, Ia.; Western Union College.
KFCZ, Omaha, Nebr.; Omeha Central High School.
KFDA, Baker, Ore.; Adler's Music Store.
KFDB, San Francisco, Calif.; Mercantile Trust Co.
KFDC, Spokane, Wash; Radio Supply Co; 283 meters; 10 wetts.
KFDD, St. Michael Cathedral, Boise, Idaho, 252 meters, 10 watts.
KFDO, Bozemen, Mont.; Everett H. Cutting.
KFDP, Des Moines, Ia.; Hawkeye Radio & Supply Co.
KFDS, San Francisco, Calif.; John D. McKee.
KFDU, Lincoln, Nebr; Nebraska Radio & Elect. Co.; 240 meters; 20 watts.
KFDV, Fayetteville, Ark.; Gilbreeh & Stinson.
KFDY, Brookings, S. D.; South Dakota State College of Agriculture and Mechanical Arts.
KFDL, Denver, Colo.; Knight Campbell Music Co.
KFDJ, Corvallis, Ore.; Oregon Agri. College.
KFDC, Spokene, Wash.; Redio Supply Co.
KFDF, Casper, Wyo.; Wyoming Radio Corp.
KFDR, York, Nebraska; Bullock's Hardware & Sporting Goods.
KFDX, Shreveport, La.; First Beptist Church.
KFDZ, Minneapolis, Minn.; Harry O. Iverson.
KFEC, Portland, Ore.; Meier & Frank Co.
KFEJ, Tacoma, Wash.; Guy Greason.
KFEL, Denver, Colo., Winner Radio Corp.
KFEP, Denver, Colo., Radio Eqolpment Co.
KFEQ, Oak Nebraska; J. L. Scroggin.
KFEQ, Oak, Nebraska; J. L. Scroggin.
KFFR, Kirk, Jim, Sparks, Nev.; 226 meters, 10 watts.
KFER, Ft. Dodge, Iowa; 231 meters, 10 watts; Auto Electric Service Co.
KFEV, Douglas, Wyo; Radio Elect. Shop; 263 meters; 100 watts.
KFEX, Minneapolis, Minn; 261 meters, 100 watts Augsburg Seminary.
KFEY, Kellogg, Idaho; Bunker Hill & Sullivan Mining & Conetruction Co.
KFFZ, Dallas, Texas; 226 meters, 20 watts; A. G. Bernes Amusement Cu.
KFEZ, St. Louis, Mo.; American Society of Mechanical Engineers.
KFFA, San Diego, Calif.; Dr. R. C. Shelton.
KFFE, Pendleton, Ore.; Eastern Oregon Radio Co.
KFFO, Billsboro, Oregon; Dr. E. H. Smith.
KFFP, Moberly, Missouri; First Beptist Church.
KFFQ, Colorado Springs, Colo.. Markheffel Motor Co.
KFFV, Lamont, Iowa; Graceland College.
KFFX, Omaha, Neb; 278 meters, 250 watts; The McGraw Co.
KFFY, Alexandrie, Le; 275 meters; 100 watts; Pincus & Murphy Ino.
KFGC, Beton Rouge, La; 254 meters, 100 wetts; Louisiana State University.
KFGD, Chickasha, Okie.; 248 meters, 20 watts; Chickasha Radio & Elect. Co.
KFGF, Mt. Vernon, Wash.; Boohanen, Stevens & Co.
KFGH, Stanford Univ., Calif.
KFGJ, St. Louis, Mo.; 266 meters, 100 watts; Nat'l Guards Missouri 138 Infantry.
KFGL, Arlington, Oregon; Arlington Garage.
KFGP, Cheney, Kansas; 229 meters, 10 watts; Cheney Radio Company.
KFGQ, Boone, Iowa; 226 meters, 20 watts; Crary Hardware Co.
KFGV, Utica, Nebreska; 224 meters, 10 watts; Heidbreder Radio Supply Co.
KFGX, Orenge, Texas; 250 meters; 500 wetts; First Presbyterian Church.
KFGY, Baudette, Minn; 224 meters, 15 wetts; Gjelhayg's Radio Shop.
KFGZ, Berrien Springs, Mich; 268 meters, 10 watts; Emmanuel Missionary College.
KFHA, Gunnison, Colo.; Colorado State Normal School.
KFHB, Hood River, Oregon; P. L. Boardwoll.
KFHD, St. Joseph, Mo.; 226 meters, 10 wetts; Utz Electric Co.
KFHF, Shreveport, Le 266 meters, 150 wetts; Central Christian Church.
KFHR, Seattle, Wash; Star Elect & Radio Co; 270 meters; 100 watts.
KFHH, Neah Bey, Wash.; Ambrose McCue.
KFHI, Wichita, Kansas; 224 meters, 20 watts; Charles V. Dixon.
KFHJ, Santa Barbara, Calif., Fallon Co.
KFHL, Oskaloose, Ia.; 227 metere, 10 watts; Penn College.
KFHP, Kearney, Nebr: Radio Bug Products Co; 246 meters; 10 watts.
KFHQ, Curtis Bros. Hardware Store, Los Gatos, Calif.; 242 meters, 5 watts.
KFHS, Dow, Clifford J., Lihue, Hawaii, 275 meters, 30 watts.
KFHS, Nelson, Robert Washington, Hutchinson, Kansas; 229 meters, 50 watts.
KFHU, Sateren, M. G., Mayville, N. D.; 261 meters, 50 watts.
KFHY, McEwan, R. S., Trinidid, Col.; 242 meters, 50 watts.
KFID, Iola, Kansas, 246 meters, 20 watts; Ross Arbuckle's Garage.
KFIQ, Yakima, Wash.; 224 meters, 50 watts; Yakima Valley Radio Broadcasting Association.
KFI, Los Angeles, Calif.; radius covers entire U. S. and Canade; Daily, 6:45 to 11 p. m. Sunday 10 to 11 a. m., 4 to 4:30 and 8 to 11 p. m.; entertainment and educational features; etation operates three remote control stations; Earle C. Anthony, Inc.
KFIB, St. Louis, Mo.; 214 meters, 10 watts; Franklin W. Jenkins.
KFIF, Portland, Ore.; Benson Tech. Student Body.
KFIC, Denver, Colorado; 224 meters, 15 watts; Philip Laskowitz.
KFIJ, Platte, S. D.; Sidney I. Thorean; 236 meters; 5 watts.
KFIK, Gladbrook, Ia; Gladhrook Electric Co; 234 meters; 20 watts.
KFIO, Spokane, Wash.; North Central High School; 252 meters; 50 watts.
KFJD, Greeley, Colo.; Weld County Printing & Puhlishing Co; 236 meters; 100 watte.
KFKH, Denver Park Amusement Co; Lakeeide, Colo; 226 meters, 10 watts.
KFIU, Alaska Elect. Light & Power Co., Juneau, Alaska, 226 meters, 10 watts.
KFU, Gridley, Calif.; The Precision Shop.
KFIV, Broyles, V. H., Pittsburg, Kansas; 240 meters, 20 watts.
KFIX, Reorganized Church of Jesus Christ, of Later Day Saints, Independence, Kans.; 240 meters, 500 watts.
KFZ, Spokane, Wash.; Doerr-Mitchell Elec. Co.
KGB, Tacome, Wash., Sunday: 5 to 7:30; Daily: 7 to 9 p. m. (except Thursday) News, Sport bulletins, lectures, entertainment, weather, tido tables, bedtime etories, time, etc.; Tecoma Deily Ledger station operated by the William A. Mulline Electric Co.
KGG, Portland, Ore.; Hallock & Watson Radio Service.
KGN, Portland, Ore.; Northwestern Radio Mfg. Co.
KGO, Altadena, Cel. 2500 milee; every Saturday 8 to 9:30 p m Musical program;
KGU, Honolulu, Hewaii, Waikiki Beach, Marion A. Mulroney; Honolulu Advertiser
KGW, Portland, Ore.; Oregonian Pub. Co.
KGY, Lacey, Wash.; St. Martin's College, (Rev. S. Ruth).
KHJ, Los Angeles, Calif.; Daily except Sunday; 12:30 p. m. to 1:15 p. m. news and concerts; 7 to 7:30 p. m. Children's Helf Hour; 8 to 9:30 p. m. De Luxe program of muele, news and educationel features; Sunday; 10 to 11 a. m. Scripture reading, sermon, prayer and sacred musical program; Pacific time; Times-Mirror company.
KHQ, Seattle, Wash.; Louis Wasmer.
KJQ, Stockton, Calif.; C. O. Gould.
KJS, Los Angeles, Calif.; Bible Inst. of Los Angeles.
KLB, Pasadene, Calif.; J. J. Dunn & Co.
KFDH, Tucson, Aris.; Univ. of Arizone.
KLN, Montercy Electric Shop, Monterey, Calif.; 261 meters, 10 watts.
KLS, Oakland, Calif.; Warner Bros.
KLX, Oeklend, Calif.; Tribune Pub. Co.
KLZ, Denver, Colo.; Claes B, 485, Reynolds Radio Co.
KMAZ, Mecon, Ga., Mercer University.
KMC, Reedley, Calif.; Lindsay-Wethorill Co.
KMJ, Fresno, Calif. Max. 2576 Miles; Musical program, San Joaquin Light & Powor Corp.
KMO, Tecome, Wash., Love Electric Co.; Tacome Times.
KNJ, Roswell, New Mexico; 1000 miles; Every evening at 8; nows, weather reports, stock market, concerts and sermons; Roswell Puhlic Service Co.
KNT, Aberdeen, Wash.; North Coest Produots Co.
KNV, Los Angeles, Calif.; Radio Supply Co.
KNX Los Angeles, Calif.; Electric Lighting Supply Co.
KOB, State College, N. Mex.; time signals and weather reports 12 noon and 10: p m, mountain time; music and lectures Monday, Wednesday and Friday. 7:30 to 8:30 p m; New Mexico College of Agriculture and Mechanical Arts.
KOE, Spokene, Wash.; Spokene Chronicle.
KOP, Detroit, Mich., Detroit Police Dept.
KOQ, Modesto, Calif., Modesto Evening News.
KPO, San Francisco, Calif., Hale Bros.
KQI, Berkeley, Calif., Univ. of California.
KQP, Hood River, Oregon; Apple City Radio Club.
KQV, Pittsburgh, Pa., Doubleday-Hill Elec. Co.
KQW, San Jose, Calif., Ches. D. Herrold.
KRE, Berkeley Daily Gazette, Berkeley, Cal.; 278 meters, 50 watts.
DSC, San Jose, Calif., O. A. Hele & Co.
KSD, St. Louis, Mo.; 1700 miles; grain, livestock, cotton, New York stocks, poultry end butter market, metal merket, official weather and news et 9:40, 10:40, 11:40, 12:40, 1:40, 2:40 and 4 p m; 8: p m 400 meters, musical end ether features; Pulitzer Publishing Co., St. Louis Post Dispatch.
KSS, Long Beach, Calif., Frost & Dean Redio Research Lab.
KSU, Wenatchee, Wash.
KTW, Seattle, Wash., First Presbyterien Church.
KUO, San Francisco, Calif., Examiner Printing Co., San Fran. Examiner.
KUS, Los Angeles, Cal. 500 milos; setting up exercises daily, 7 to 7:30 e m and 12:00 noon to 12:30 p m; concert, 65 voices, 6 to 6:45 p m, Wednesdays end Fridays; City Dye Works.
KUY, Del Monte Calif., Coast Radio Co.
KWG, Stockton, Cal. Deily Merket reports, music and news 4 to 5 p m; Music, 2 to 3 p m, Sundey; Tuesdays and Fridays, music, 8 to 9 p m. Portable Wireless Telephone Co.
KWH, Los Angeles, Calif., Los Angeles Exeminer.
KXD, Modesto, Calif., Herald Publishing Co.
KYQ, Honolulu, T. H., The Electric Shop.
KYW, Chicago, Ill.; Westinghouse Elec. & Mfg. Co. 345 meters.
KZM, Oakland, Calif., Western Radio Inst.; Presten D. Allen.
KZN, Salt Lake City, Utah, The Desoret News.
KZV, Wenatchee, Wash., Wenatchee Battery & Moter Co.
NOF, Anacostia, D. C., U. S. Nevy Dept.
PWX, Havana, Cuba, Cuban Telephone Co.
WABD, Dayton, Ohio; 286 meters, 10 watts; Perker High School.
WAI, Dayton, Ohio, McCook Field, U. S. Army.
WAAB, New Orleans, La., Veldomar Jensen.
WAAC, New Orleans, La., Tulane Univ.
WAAD, Cincinnati, Ohio, Ohio Mechenics Inst.
WAAF, Chicago, Ill., Chicago Daily Drovers Journal.
WAAE, St. Louis, Mo., St. Louis Chamber of Commerce.
WAAH, St. Paul, Minn.; Commonwealth Electric Co.
WAAK, Milwaukee, Wis., Gimbel Bros.
WAAL, Minneapolis, Minn., Minnesota Tribune Co. & Anderson-Beemish Co.

(Continued on next page.)

Complete Corrected List of U. S. and Canadian Broadcasting Stations

WAAM, Newark, N. J, 200 miles; musical and code, every week day 11 to 11:55 a m, 3 to 4 p m: Wednesday evenings 8 to 9; I. R. Nelson Company.
WAAN, Columbia, Mo., Univ. of Missouri.
WAAP, Wichita, Kans., United Elec. Co.; Otto W. Taylor.
WAAQ, Greenwich, Conn., New England Motor Sales Co.
WAAS, Decatur, Ga., Georgia Radio Co.
WAAT, Jersey City, N. J., Jersey Review.
WAAW, Omaha, Neb., Omaha Grain Exchange.
WAAZ, Emporia, Kans.; Daylite 100 miles; nite 500-1000 miles; each Tuesday and Thursday from 7 to 8 p m. Acknowledge all communications at 7:15 p m. The Hollister Miller Motor Co.
WABA, Lake Forest, Ill; 266 meters, 100 watts; Lake Forest College.
WABB, Harrisburg, Pa; 266 meters, 10 watts; Dr. John B. Lawrence.
WABC, Anderson, Ind; 299 meters, 10 watts, Fulwider-Grimes Battery Co.
WABD, Dayton, Ohio; 286 meters, 10 watts; Parker High School.
WABE, Washington, D. C; 283 meters. 50 watts; Y. M. C. A.
WABF, Mt. Vernon, Ill; 234 meters. 250 watts; Mt. Vernon Register-News Co.
WABG, Jacksonville, Fla; Arnold Edwards Piano Co. 248 meters; 10 watts.
WABM, Doherty, F. E. Saginaw, Mich.; 254 meters, 100 watts.
WABO, Lake Avenue Baptist Church, Rochester, N. Y.; 252 meters, 30 watts.
WABI, Bangor, Me: Bangor Railway and Elect. Co.; 240 meters; 50 watts.
WABJ, South Bend, Ind; The Radio Laboratories; 240 meters; 50 watts.
WAJT, Marshall, Me., Kelly-Vawter Jewelry Co.
WAJU, Yankton, S. D., Yankton College.
WABH, Sandusky, Ohio; 234 meters, 100 watts; Lake Shore Tire Co.
WBAA, W. Lafayette, Ind., Purdue University.
WBAD, Minneapolis, Minn., Sterling Elec. Co. & Journal Printing Co.
WBAE, Peoria, Ill., Bradley Polytechnic Inst.
WBAF, Moorestown, N. J., Fred M. Middleton.
WBAG, Bridgeport, Pa., Diamond State Fibre Co
WBAM, New Orleans, La., L. B. Bennyson.
WBAN, Paterson, N. J., Wireless Phone Corp.
WBAO, Decatur, Ill.; 100 miles; occasional music; sermons; James Millikin Univ.
WBAP, Fort Worth, Tex.; 4000 miles; Markets and News; Feature concert Monday to Friday inclusive; 9:30 p m to 10:45 p m, Central Time; Quiet nights Saturday and Sunday. The Star-Telegram.
WBAQ, Sonth Bend, Ind., Myron L. Harmon.
WBAU, Hamilton, Ohio, Republican Publishing Co.
WBAV, Columbus, Ohio, Erner & Hopkins Co.
WBAW, Marietta, Ohio; Marietta College: 246 meters; 100 watts.
WBAX, Wilkes-Barre, Pa., John H. Stenger, Jr.
WBBA, Newark, O.; 240 meter, 20 watts; Newark Radio Lab.
WBBC, Sterling, Ill; 229 meter, 50 watts; Sterling Radio Equipment Co.
WBBD, Reading, Pa; Barbey Battery Service; 224 meters; 50 watts.
WBL, Anthony, Kans; T & H Radio Co; 261 meters; 100 watts.
WBS, Newark, N. J.; Radius 500 mi.; Musical and Educational, week days: 10:30 to 11 a. m.; 1:00 to 1:15 p. m.; 2:15 to 2:30 p. m.; 7:30 to 8:30 p. m.; Sundays: 9 to 10:30 a m; 1 to 3 p m; D. W. May, Inc.
WBT, Charlotte, N. C. 1200 miles; 11: a m weather report 485; 4:30 p m mechanical music; 8: p m Market Report; 8:30 Tuesday and Friday regular concert; 7:30 p m Sunday, Church Southern Radio Corp.
WBU, Chicago, Ill., City of Chicago.
WBZ, Springfield, Mass., Westinghouse Elec. & Mfg. Co.
WCAD, St. Lawrence University, Canton, N. Y.; 280 meters, 50 watts.
WCAE, Pittsburgh, Pa.; 12:30 news and reports; 3:30 weatehr reports; 4:15 Closing Market reports; 7:30 Late news and lecture; 8:30 musical programs; Kaufmann Baer Co.
WCAG, New Orleans, La., Daily States Pub. Co.
WCAH, Columbus, O. Daily program 11:30 to 12:30; Every Tuesday evening at 7, musical program; C. A. Entrekin Electric Co.
WCAI, San Antonio, Texas, Southern Equipment Co.
WCAJ, Univ. Place, Neb., Nebraska Wesleyan University.
WCAK, Houston, Texas, Alfred P. Daniel.
WCAL, Northfield, Minn., St. Olaf College.
WCAM, Villanova, Pa., Villanova College.
WCAO, Baltimore, Md., Sanders & Stayman Co.
WCAP, Chesapeake & Potomac Tel. Co., Washington, D. C.; 469 meters, 500 watts.
WCAR, San Antonio, Texas, Alamo Radio Elec. Co.
WCAS, Minneapolis, Minn., Wm. H. Dunwoody Industrial Inst.
WCAT, Rapid City, S. Dak., South Dakota School of Mines.
WCAU, Philadelphia, Pa.; 1000 miles; Daily 10:30 a. m.; 2:30 p. m.; 6:30 p m; regular concert 10 to 12 noon; Tuesdays, Fridays, Saturdays; Durham & Co., Inc.
WCAV, Little Rock, Ark., J. C. Dice Elec. Co.
WCAW, Omaha, Nebr., Woodmen of the World.
WCAX, Burlington, Vermont, University of Vermont.
WCAY, Milwaukee, Wis., Kesselman O'Driscoll Co.
WCBA, Allentown, Pa.; Chas. W. Haimbach; 280 meters; 5 watts.
WCBB, Greenville, O.; 240 meters, 100 watts; K. & K. Radio Supply Co.
WCBD, Voliva, Wilhur Glenn, Zion, Ill.; 345 meters, 500 watts.
WCE, Minneapolis, Minn., Findley Elec. Co.
WCK, St. Louis, Mo., Stix Baer & Fuller.
WCM, Austin, Texas, Univ. of Texas.
WCX, Detroit, Mich., Detroit Free Press.
WDAD, Lindsburg, Kas.; Central Kansas Radio Supply.
WDAE, Tampa, Fla., Tampa Daily News.
WDAF, Kansas City, Mo; Kansas City Star; 411 meters; 500 watts. Regular concerts on Mon, Wed. and Fri. nights from 8 to 9:30. Concerts from 3:30 to 4:30 p m each afternoon except Sun. Baseball scores 3:25, 4:00, 4:30, 5:00, and 5:50 p. m. Marketgram and weather forecast 5:55 nightly, except Sun. Educational features and musical program 6 to 7 o'clock each night except Sunday. "Nighthawk" Frolic, Coon Sanders orchestra at the Hotel Muehlebach nightly except Sun. 11:45 p. m. to 1 a. m.
WDAG, Amarillo, Texas, K. Laurence Martin.
WDAG, Brownsville, Pa., Hartman-Riker Elec. & Mach.Co.
WDBF, Phillips, Robert G., Youngstown, Ohio; 261 meters, 50 watts.
WDAH, El Paso, Tex.; Trinity Methodist Church.
WDAJ, Ervins El. Co., Parson's, Kan. 258 meters, 15 watts.
WDAI, Syracuse, N. Y., Hughes Electrical Corp.
WDAK, Hartford, Conn., Hartford Courant.
WDAL, Jacksonville, Fla., Florida Times Union.
WDAO, Dallas, Texas, Automotive Elec. Co.
WDAP, Chicago, Ill., markets, and concerts 860; Daily on all business days: 9:30 a. m. receipts and shipments; estimated car lots; local weather report; opening futures market in wheat, corn, oats, rye, barley, pork, lard and ribs. 10 a. m. Future quotations, live stock receipts and prices; 10:30 a. m. futures quotations; 11 and 11:30 a m. same; 12 noon, futures and cash grain prices; 12:30 and 1 p. m. futures quotations; 1:20 p. m. closing futures quotations and high and low for day. Cash grain prices. Gross bids for cash grain to arrive. 6 p. m. closing quotations; news items. On Saturdays closing prices at 12:05 p. m. instead of 1:20 p. m. Visible supply changes sent when posted. Regular concert schedule 10 p. m. Tuesdays, Thursdays and Saturdays. Sunday evenings 9 p. m. and 10 p. m. Chicago Board of Trade official station.
WDAR, Philadelphia, Pa.; Lit Brothers.
WDAS, Worcester, Mass., Samuel A. Waite.
WDAU, New Bedford, Mass., Slocum & Kilburn.
WDAX, Centerville, Iowa; First National Bank 268 meters, 100 watts.
WDAY, Fargo, N. D.; 244 meters, 50 watts; Fargo Radio Service Co.
WDM, Washington, D. C., Church of the Covenant.
WDT, New York, N. Y., Ship Owners Radio Service.
WMZ, Tuscola, Ill., James L. Bush.
WEAA, Fallain & Lathrop, Flint, Mich.; 280 meters; 150 watts.
WEAB, Fort Dodge, Iowa, Standard Radio Equip. Co
WEAD, Atwood, Kans., Northwest Kansas Radio Supply Co.
WEAE, Blacksburg, Va., Virginia Polytechnic Inst.
WEAF, New York City, N. Y., Western Electric Co.
WEAG, Edgewood, R. I., Nichols-Hineline-Bassett Lab.
WEAH, Wichita, Kans., Wichita Board of Trade and Lander Radio Co
WEAI, Ithaca, N. Y., Cornell University.
WEAJ, Vermilion, S. Dak., University of South Dakota.
WEAK, St. Joseph, Mo., Julius B. Abercrombie.
WEAM, North Plainfield, N. J., Burough of N. Plainfield
WEAN, Shepard Co., The, Providence, R. I.; 273 meters, 100 watts.
WEAO, Columbus, Ohio, Ohio State University.
WEAP, Mobile, Ala., Mobile Radio Co.
WEAQ, Berlin, N. H., Y. M. C. A.
WEAR, Baltimore, Md., Balt. American & News Pub. Co
WEAS, Washington, D. C., The Hecht Co.
WEAU, Sioux City, Iowa, Davidson Bros. Co.
WEAY, Houston, Texas, Will Horwitz, Jr.
WEAZ, Waterloo, Iowa, Donald Redmond.
WEB, St. Louis, Mo., The Benwood Co., Inc
WEV, Houston, Texas, Hurlburt-Still Elec. Co.
WEW, St. Louis, Mo., St. Louis Univ.
WEW, St. Louis, Mo., Market and weather reports at 9 a. m., 10 a. m., and 2: p m; no other regular program; St. Louis University.
WEY, Wichita, Kansas, Cosradio Co.
WFAA, Dallas, Texas. A. H. Belo & Co.
WEAB, Syracuse, N. Y., C. F. Woese.
WFAC, Superior, Wis., Superior Radio Co.
WFAF, Poughkeepsie, N. Y., H. C. Spratley Radio Co.
WFAG, Waterford, N. Y., Radio Engineering Lab.
WFAH, Port Arthur, Texas, Elec. Supply Co.
WFAJ, Asheville, N. C., Hi-Grade Wireless Instrument Co.
WFAK, Brentwood, Mo., Domestic Electric Co.
WFAM, St. Cloud, Minn., Granite City Elec. Co. and Times Pub. Co.
WFAN, Hutchinson, Minn., Hutchinson Electric Service Co.
WFAQ, Cameron, Mo., Cameron Radio Co. and Mo. Wesleyan College.
WFAT, Sioux Falls, S. Dak.; also Argus-Leader.
WFAV, Lincoln, Nebr., Univ. of Nebr. Dept. of Elec. Engineering.
WFI, Philadelphia, Penn., also Strawbridge & Clothier.
WGAC, Brooklyn, N. Y., Orpheum Radio Stores Co.
WGAD, Ensenada, Porto Rico, Spanish-American School of Radio-telegraphy.
WGF, Des Moines, Iowa 800 miles; Musical and entertainment Tuesday and Friday 7:30 p m; Church Services Sunday at 5 p m or 7:45 p m as announced; Special programs as announced Register and Tribune.
WGAJ, Shenandoah, Iowa, W. H. Gass.
WGAL, Lancaster, Pa.; Lancaster Elect. Supply Co. 248 meters; 10 watts.
WGAN, Pensacola, Fla., Cecil E. Lloyd.
WGAQ, Shreveport, La., Glenwood Radio Corp.
WGAR, Fort Smith, Ark., Southwest American.
WGAU, Wooster, Ohio; 226 meters, 20 watts: Marcus G. Limb.
WGAV, Savannah, Ga., B-H Radio Co.
WGAW, Altoona, Pa., Ernest C. Albright.
WGAX, Washington Court House, Ohio, Ohio Radio Elec. Co.
WGAY, Madison, Wis., North Western Radio Co.
WGAZ, South Bend, Ind., South Bend Tribune.
WGI, Medford Hillside, Mass., Am. Radio & Research Corp.
WGL, Philadelphia, Pa., Thos. F. J. Howlett.
WGM, Atlanta, Ga., Atlanta Constitution.
WGR, Buffalo, N. Y., Federal Tel. & Teleg. Co.
WGV, New Orleans, La., Interstate Elec. Co.
WGY, Schenectady, N. Y., General Elec. Co.
WHA, Madison, Wis., Univ. of Wis.
WHAA, Iowa City, Ia; 500 miles; 8:30 p m, Monday, Instruction; Tuesday, concert; Wednesday, popular lecture; Friday, University News; public lectures and concerts irregularly; State University of Iowa.
WHAB, Galveston, Texas, Clark W. Thompson (Fellman's Dry Goods Co.)
WHAC, Waterloo, Iowa, Cole Bros. Elec. Co.
WHAD, Marquette Univ., Milwaukee, Wis.; 280 meters, 100 watts.
WHAG. Cincinnati, Ohio, Univ. of Cincinnati.
WHAH, Joplin, Mo; radius, 1384 mi.;Concerts, markets, weather, etc. Tuesday and Thursday evenings: 8 to 10; Daily except Sundaya: 10 a. m. to 2 p. m.; Saturday night special: 11 to 12:30; Hafer Supply Co.
WHAI, Davenport, Iowa, Radio Equip. & Mfg. Co.
WHAJ, Bluefield, W. Va., Bluefield Daily Telegraph and E. K. Kitts.
WHAK, Clarksburg, W. Va., Roberts Hdwe. Co.
WHAL, Lansing, Mich., Lansing Capitol News.
WHAM, Rochester, N. Y. Daily—Weather reports 2:40 p. m.; Organ 2:45, 5:00, 6:45; Orchestra 3:00, 7:00; Bed-time stories, Sport results, Business reports and market reports, the latter on 485 meters, 7:15 p m; Sunday—Radio Chapel Service, 8:15 p m; University of Rochester.
WHAO, Savannah, Ga., Frederick A. Hill; every evening 8 to 9; Saturday nights, 12:30 1:30 a. m.
WHAP, Decatur, Ill., Dewey L. Otta.
WHAQ. Washington, D. C., Semmes Motor Co.
WHAR, Paramount Radio & Elect. Co., Atlantic City, N. J.;231 meters, 15 watts.
WHAS. Louisville, Ky., Courier Journal and Louisville Times Co.
WHAV, Wilmington, Del., Wilmington Elec. Spec. Co.
WHX, Des Moines, Iowa; 300 miles; 5:45 p m to 6:15 p m Daily; 8:00 p m to 10 p m Wednesday evenings; Central Standard time; Iowa Radio Corp.
WHAY, Huntington, Ind., Huntington Press.
WHAZ, Troy, N. Y., Rensselaer Polytechnic Inst.
WHB, Kansas City, Mo., Sweeney Auto & Tractor School.
WHD, Morgantown, W. Va., W. Va. University.
WHK, Cleveland, Ohio, Warren R. Cox.
WHN, Ridgewood, N. Y., Times Printing & Pub. Co.
WHU, Toledo. Ohio, Wm. B. Duck Co.
WIAB, Joslyn Automobile Co., Rockford, Ill.; 252 meters, 50 watts.
WIAC, Galveston, Texas, Galveston Tribune.
WIAD. Ocean City, N. J., Ocean City Yacht Club.
WIAF, New Orleans, La; G. A. DeCortin, 10 Marlborough Gate; 234 meters, 10 watts.
WJAG, Norfolk, Nebr; 200 miles News and Markets 12:15, 3:30 and 5:30 p. m The Huse Publishing Co. The Norfolk Daily News.
WIAH, Newton. Iowa, Continental Radio & Mfg. Co.
WIAI, Springfield, Mo., Heer Stores Co.
WIAJ, Neenah. Wis., Fox River Valley Radio Supply Co.
WIAK, Omaha, Nebr.; 7:45 a. m. Livestock receipts; 9:10 a. m. Livestock receipts and opening on hogs; 10:15 a m rainfall and temperature report and weather forecast for Nebraska and Iowa, Livestock market; 12 m cattle, hog and sheep market; 1:50 p m rainfall and temperature report and weather forecast for Nebraska and Iowa; market detail; 3:50 p m complete market reports and estimated receipts for next day: Daily Journal-Stockman.
WIAO, Milwaukee, Wis., School of Engineering.
WIAP, Springfield, Mass., Radio Development Corp.
WIAQ, Marion, Ind., Chronicle Pub. Co.
WIAR, Paducah, Ky., Musical 3:30 to 4 p. m. and 7 to 8 p. m. except Sundays Paducah Evening Sun; Albert Bennett, operator.
WIAS, Burlington, Iowa, Hawk-Eye Home Elec. Co.
WIAT, Tarkio, Mo., Leon T. Noel.
WIAU, Le Mars, Iowa, Am. Trust & Savings Bank
WIAV, Binghamton, N. Y., N. Y. Radio Lab.
WIAW, Saginaw, Mich., Saginaw Radio & Elec. Co
WIAY, Neenah, Wis; 224 meter, 100 watts; Fox River Valley Radio Supply Co.
WIK, McKeesport, Pa., K. & L. Elec. Shop.
WIL, Washington, D. C., Continental Elec. Supply Co
WIP, Philadelphia, Pa., Gimbel Bros.
WIZ, Cincinnati, Ohio, Cino Radio Mfg. Co.
WJAB, Lincoln, Nebr., American Radio Co.
WJAD, Waco, Texas. Jackson's Radio Engrng. Lab.
WJAF, Muncie, Ind; 1800 miles; 7:30 to 8 Monday, Wednesday, Friday evening, music; 6:30 to 7 p m Saturday, music; 3:30 to 4 every afternoon, News; 10:30 to 12 M Sundays, Church service. Smith Electric-Muncie Press.

(Continued on next page.)

Complete Corrected List of U. S. and Canadian Broadcasting Stations

WJAJ, Dayton, Ohio 200 miles; Sunday 8:40, 9:15 Religious; Wednesday 9:15, 9:45 Entertainment; Friday 9:15 to 9:45 Entertainment. Y. M. C. A.
WJAK, Stockdale, Ohio White Radio Lab.
WJAM, Cedar Rapids, Ia; D. C. Perham, 268 meters, 20 watts.
WJAN, Peoria, Ill; 280 meters, 100 watts; Daily except Sunday: 9 a. m. Peoria Livestock; 9:15 a. m. Special Weather Information; 11:30 a. m. weather, opening livestock and market quotations; 1:30 p. m. Closing livestock and markets, official weather information; talk to women by Phyills Ann; Monday and Thursday, government agriograms; 5:30 p. m. baseball reports during season; Tuesday, Thursday and Saturday, special concerts as announced at 9:15 p. m.; One musical number preceeds each broadcasting. Peoria Evening Star.
WJAP, Duluth, Minn. 1500 miles; Sunday 11 a m, 12:30 p m Church Service and organ recital; First Methodist Church, Rev. Chas. N. Pace, Pastor. Monday 8: p m to 9 p m, musical; Thursday 8 p m to 9 p m. musical; Kelley Duluth Co.
WJAQ, Topeka, Kans., Capper Publications.
WJAR, Providence, R. I., The Outlet Co., J. Samuels & Bros.
WJAS, Pittsburgh, Pa., Pittsburgh Radio Supply House.
WJAT, Marshall, Mo., Kelley-Vawter Jewelry Co.
WJAX, Cleveland, Ohio, Union Trust Co.
WJAZ, Chicago, Ill., Chicago Radio Lab.
WJD, Granville, Ohio; 229 meters, 50 watts; Richard Harris Howe.
WJH, Washington; D. C., White & Boyer Co.
WJX, New York, N. Y., De Forest Radio Telephone & Teleg. Co
WJZ, New York, Radio Corp. of America; Aeolin Hall, 455 meters.
WKAA, Cedar Rapids, Ia.; Daily; weattber reporte, crop reports, government reports; Mondays, Thursdays and Saturdays: music; H. F. Paar.
WKAC, Lincoln, Nebr; Star Publishing Co; 275 meters; 100 watts.
WKAD, Looff, Charles, East Providence, RI.; 240 meters, 10 watts.
WKAF, Wichita Falls, Texas, W. S. Radio Supply Co.
WKAN, Montgomery, Ala., Alabama Radio Mfg. Co.
WKAP, Cranston, R. I., Dutee W. Flint.
WKAQ, San Juan, Porto Rico, Radio Corp. of Porte Rico
WKAR, Michigan Agri. College, East Lansing, Mich., 280 meter, 100 watts.
WKAS, Springfield, Mo., L. E. Lines Music Co.
WKAV, Laconia, N. H., Laconia Radio Club.
WKAW, Beloit, Wis; 242 meters, 10 watte; Turner Cycle Co.
WKAX, Bridgeport, Pa; W. A. McFarlane; 231 meters; 15 watts.
WKAY, Gainesville, Ga., Brenau College.
WKC, Baltimore, Md., Jos. M. Zamolski Co.
WKY, Oklahoma City, Okla., Oklahoma Radio Shop.
WLZ, Fairfield, Ohio, U. S. Army.
WLAC, Raleigh, N. C., N. C. State College.
WLAG, Minneapolis, Minn., Cutting & Walsh Radio Corp.
WLAH, Syracuse, N. Y., Samuel Woodwortb.
WLAJ, Waco, Texas, Waco Elec. Supply Co.
WLAK, Bellows Falls, Vt., Vermont Farm Machine Co.
WLAL, Tulsa, Okla., Tulsa Radio Co.
WLAN, Houlton, Me., Putnam Hdwe. Co.
WLAP, Louisville, Ky., W. Y. Jordan.
WLAQ, Kalamazoo, Mich., A. E. Schilling.
WLAT, Burlington, Iowa, Radio Specialty Co.
WLAV, Pensacola, Fla.; daily musical program, 8 to 9 p m; The Electric Sbop.
WLAW, New York, N. Y., New York Police Dept.
WLAX, Greencastle, Ind., Greencastle Community Broadcasting Station.
WLAY, Fairbanks, Alaska, Northern Commercial Co.
WLAZ, Warren, Ohio, Hutton & Jones Elec. Co.
WLB, Minneapolis, Minn., Univ. of Minn.
WLW, Cincinnati, Ohio, Crosley Mfg. Co.
WMA, Anderson, Ind., Arrow Radio Lab.
WMAB, Oklahoma City, Okla., Radio Supply Co.
WMC, Memphis Commercial Appeal; Memphis, Tenn.
WMAC, Cazenovia, N Y; J. Edw. Page; 261 meters; 50 watte.
WMAD, Rockport, Mo., Atchinson County Mail.
WMAE, Dartmouth, Mass., Bound Hills Radio Corp.
WMAH, Lincoln, Nebr., General Supply Co.
WMAJ, Kansas City, Mo., Drovers Telegram.
WMAK, Lockport, N. Y., Norton Labs.
WMAL, Trenton, N. J, 100 miles; 7:30 to 9 p m, Mondays and Tbursdays, musical programs, lectures etc; Trenton Hardware Co.
WMAN, First Baptist Church, Columbus, Obio; 286 meters; 20 watts.
WMAN, Columbus, Ohio, First Baptist Church.
WMAP, Easton, Pa., Utility Battery Service.
WMAQ, Fair Store Building, Cbicago; 4:35 to 5 p m, daily; 7 to 7:30 p m, Monday, Wednesday, Friday and Saturday; 7 to 8 p m, Tuesday and Thursday; 9:15 to 10 p m daily; Chicago Daily News and Fair Department Store.
WMAV, Auburn, Ala., Polytechnic Inst.
WMAW, Wahpeton, N. D., Wahpeton Elec. Co.
WMAY, St. Louis, Mo., 600 miles; Religious services Sunday, 11 a m and 8 p m; Tuesday at 7 p m; Kingshighway Presbyterian Church.
WMAZ, Macon, Ga., Mercer University.
WMH, Cincinnati, Ohio, Precison Equipment Co.
WMAT, Paramount Radio Corp., Duluth Minn.; 266 meters, 25 watts.
WMU, Washington, D. C., Doubleday-Hill Electric Co.
WNAB, Bowling Green, Ky., Park City Daily News.
WNAC, Boston, Mass.; Monday 4 to 5 p. m. (silent at night) Tuesday 4 to 5 p. m. and 7 to 8:30 p. m. Wednesday 4 to 5 p. m. 9:30 to 11 p. m. Thursday 4 to 5 and 7 to 8:30 p. m. Friday 4 to 5 and 8 to 9:30 p. m. Saturday 4 to 5 and 9:30 to 11 p. m. The Shepard Stores; J. J. Fanning, announcer Samuel Curtis, operator, 278 meter, 100 watts.
WNAD, Norman, Okla., Okla. Radio Engineering Co.
WNAL, Omaha, Nebr., R. J. Rockwell.
WNAN, Syracuse, N. Y., Syracuse Radio Telephone Co.
WNAP, Springfield, Ohio, Wittenberg College.
WNAQ, Charleston, S. C., Charleston Radio Elec. Co.
WNAS, Austin, Texas, Radio Corp.
WNAT, Philadelphia, Pa. 1000 miles; Talks, Radio information, music, Chapel Service. Wednesday 7:30 p m; Saturday 7:30 p m; Sunday 2:30 and 4:30; Every day 12:15, 1 p m. Lennig Bros. Co.
WNAV, Knoxville, Tenn., People's Tel. and Tel. Co.
WNAY, Baltimore, Md., Sbipowners' Radio Service.
WNAW, Fortress Monroe, Va., Henry Kunzman.
WNAX, Yankton, S. Dakota; 244 meters, 100 watts; Dakota Radio Apparatus Company.
WNJ, Albany, N. Y., Sbotton Radio Mfg. Co., Inc.
WNO, Jersey City, N. J., Wireless Telephone Co. of Hudson Co., N. J
WOAA, Ardmore, Okla.; radius 1,500 miles; Tuesdays and Fridays: musical and educational programs; Dr. Walter Hardy; station operated by G. H. Reltz.
WOAC, Lima, Ohio, Maus Radio Co.
WOAE, Fremont, Nebr., Medland College.
WOAF, Tyler, Texas, Tyler Commercial College.
WOAH, Charleston, S. C., Palmetto Radio Corp.
WOAI, San Antonio, Tex; 385 meters; Southern Equipment Company; Programs Daily; 10:30 a m Opening markets, U S weather forecast, crop reports, road reports, cotton reports, money market, livestock quotations and news bulletins, daily except Sun. 12:15 p m. Livestock quotations, produce markets, and news bulletins. 3 p m Closing markets, cotton reports, grain and market futures and news bulletins. 7 p m Complete baseball scores from American National and Texas leagues, final reports on markets, and news bulletins. Daily except Sun. 9:30 to 10:30 p m Concerts. Tburs. 7:30 to 8:30 p m Musical and Community Programs. Sunday 11:00 a m Church Services, 5:00 to 6:00 p m Concerts.
WOAJ, Parsons, Kans., Erving's Electrical Co.
WOAK, Frankfort, Ky., Collins Hardware Co.
WOAL, Webster Groves, Mo., Wm. E. Woods.
WOAN, Lawrenceburg, Tenn., James D. Vaughan.
WOAQ, Omaha, Nebr. 100 miles; Woodmen of the World.
WOAQ, Portsmouth, Virginia; Portsmouth Kiwanis Club.
WOAR, Kenosha, Wis., Henry P. Lundskow
WOS, Jefferson City, Mo. Missouri State Marketing Bureau; 441 meters, 500 watts; first fifteen minutes of every hour from 8 a. m. to 2 p m.; markets and music at 5 p. m. Monday, Wednesday and Friday nights, 8 to 9:30 concerts. No Sunday program.
WQAT, Wilmington, Del., Boyd Martell Hamp.
WOAV, Erie, Pa., Pa. Nat'l Guard.
WOAX, Trenton, N. J., Franklin J. Wolff.
WOAW, Omaha, Neb., 100 miles, Woodmen of tbe World.
WOAZ, Stanford, Texas, Penick Hughes Co.
WCBB, Greenville, O; 240 meters, 100 watts; K. & K. Radio Supply Co.
WOC, Davenport, Ia. time signals, 10:55 a. m.; weather 11 a. m.; 360 meters, 11:05 opening market quotations, agriograms; 12:00 noon, chimes concert; 2:00 p m, closing stocks and markets; 3:30 p m, educational talk; 5:45 p m chimes concert; 6:35, sandman's visit; 7:00 musical program; 8 p m, lecture; Sundays, religious and musical and religious features, 9 a m to 10 p m; Palmer's School of Chiropractic.
WOI, Ames, Ia., Iowa State College.
WOK, Pine Bluff, Ark., concerts Tuesday and Friday evenings beginning at 9; Sundays, song service and sermens from churches at 11 a. m. and 7:30 p. m., Arkansas Light & Power Co.
WOO, Philadelphia, Pa., John Wanamaker.
WOQ, Kansas City, Mo., Western Radio Co.
WOR, Newark, N. J., L. Bamberger & Co.
WOV, Omaha, Nebr., R. B. Howell.
WPA, Fort Worth, Texas, Fort Worth Record.
WPAB, State College, Pa.
WPAC, Okmulgee, Okla., Donaldson Radio Co.
WPAD, Chicago, Ill., Wieboldt & Co.
WPAF, Council Bluffs, Iowa, Peterson's Radio Co.
WPAG, Independence, Mo., Central Radio Co.
WPAH, Waupaca, Wis., Wisconsin Dept. of Markets.
WPAJ, New Haven, Conn., Doolittle Radio Corp.
WPAK, Fargo, N. D., North Dakota Agricultural College.
WPAL, Columbus, Ohio, Superior Radio & Tel. Equip. Co.
WPAM, Topeka, Kans., Awerbach & Guettel.
WPAP, Winchester, Ky., Theo. D. Phillips.
WPAQ, Frosthurg, Md., General Sales & Eng. Co.
WPAQ, Wilmington, Del., Radio Installation Co., Inc.
WPAR, Beloit, Kans., R. A. Ward.
WPAS, Amsterdam, N. Y., J. & M. Electric Co.
WPAT, El Paso, Texas, St. Patrick's Cathedral.
WPAU, Moorhead, Minn., Concordia College.
WPAZ, Charleston, W. Va., Dr. John R. Koch.
WFG, New Lebanon, O. Nushawg Poultry Farm; 234 meters, 50 watts.
WPI, Clearfield, Pa. Electric Supply Co.
WQAW, Washington, D. C.; Catholic University of Am.; 236 meters; 50 watts.
WSAC, Clemson College, S. C.; Clemson Agriculture College.
WQAA, Parkersburg, Pa. 1500 miles; 10:30 p m every evening. Horace A. Beale, Jr.
WQAB, Springfield, Mo., Southwest Missouri State Teachers' College.
WQAC, Amarillo, Texas, E. B. Gish.
WQAD, Waterbury, Conn., Whitall Electric Co.
WQAE, Moore Radio News Station, Springfield, Vermont; 275 meters, 50 watts.
WQAF, Sandusky, Ohio, Sandusky Register.
WQAH, Lexington, Ky., Brock-Anderson Elect. Eng Co.
WQAJ, Ann Arbor, Mich., Ann Arbor Times-News.
WQAK, Dubuque, Iowa, Appel-Higley Elec. Co.
WQAL, Cole County Tel. & Tel. Co., Mattoon, Ill.; 258 meter, 10 watts.
WQAM, Miami, Fla., Electrical Equipment Co.
WQAN, "The Voice of Anthracite," 280 meters, 150 watts; Scranton Times, Scranton, Pa., musical and informative programs thrice daily; 12:30, 4:30 and 7:30 p. m. except Sunday. Music, news, weather forecasts and reports baseball scores, market quotations, evening bedtime stories. Special musical programs by vaudeville and other artists on Tuesday and Friday evenings at 8 p. m.
WQAO, New York, N. Y., Calvary Baptist Church.
WQAP, Lincoln, Nebr., Am. Radio Co.
WQAQ, Abilene, Texas, West Texas Radio Co.
WQAR, Muncie, Ind., Press Publishing Co.
WQAS, Lowell, Mass.; Prince-Walter Company.
WQAT, Westhampton, Va.; Radio Equipment Corp.
WQAV, Huntington & Guerry, Inc., Greenville, S. C.; 258 meters, 15 watts.
WQAW, Scranton, Pa., Scranton Times.
WQAW, Washington, D C; Catholic University of America; 236 meters; 50 watts.
WQAX, Peoria, Ill.; Radio Equipment Co.
WQAY, Hastings, Nebr., Gaston Music & Furniture Co.
WQAZ, Greensboro, North Carolina; Greensboro Daily News.
WRAA, Houston, Texas, Rice Institute.
WRAB, Savannah, Ga.; Savannah Board of Public Education.
WRAD, Marion, Kansas. Taylor Radio Shop.
WRAF, Laporte, Ind; 224 meters, 10 watts; Radio Club, Inc.
WRAH, Providence, R. I.; Stanley N. Read.
WRAL, St. Croix Falls, Wis.; Northern States Power Co.
WRAM, Carthage, Ill., Robert E. Comptoo & Carthage College.
WABN, Grover, Waldo C., La Crosse, Wis.; 234 meters, 100 watts.
WRAN, Waterloo, Iowa; 229 meters, 20 watts; Black Hawk Electrical Co.
WRAO, St. Louis, Mo., Radio Service Co.
WRAP, Winter Park, Fla.; Winter Park Electric Construction Co.
WRAR, David City, Nebr; J. C. Thomas; 226 meters; 20 watts.
WRAS, McLeansboro, Ill.; Radio Supply Co.
WRAU, Amarillo, Texas, Daily News.
WRAV, Yellow Springs, O., Antioch College.
WRAW, Good, Horace D., Reading, Pa.; 238 meters, 10 watts.
WRAX, Flexon's Garage, Gloucester City, N. J.; 268 meters, 50 watts.
WRAY, Scranton, Pa.; radius 400 mi.; Sunday Chapel service; Wednesday; Selective Musical program, 8:15 to 10; Saturday; 8:15 to 11; Radio Sales Corp., 280 meters, 100 watts.
WRAZ, Radio Shop of Newark, Newark, N. J. 233 meters, 50 watts.
WRK, Hamilton, Ohio, Doron Bros. Elec. Co.
WRL, Schenectady, N. Y., Union College.
WRM, Urbana, Ill., Univ. of Ill.
WRP, Camden, N. J., Federal Inst. of Radio Telg.
WRR, Dallas, Texas, City of Dallas, Police and Fire Signal Dept.
WRW, Tarrytown, N Y; Tarrytown Radio Research Lab; 275 Meters; 50 watts.
WSAA, Marietta, O., B. S. Sprague Electric Co.
WSAB, Cape Girardeau, Mo., Southeast Mo. State College.
WSAC, Clemson College, S. C.; Clemson Agricultural College.
WSAG, Davis, Loren V., St. Petersburg, Fla.; 244 meters, 10 watts.
WSAH, Chicago, Ill.; A. G. Leonard, Jr.; 248 meters, 500 watts.
WSAJ, Grove City, Pa., Grove City College.
WSAK, Daily News, The, Middleport, Ohio; 258 meters, 20 watts.
WSAL, Brookville, Ind.; Franklin Electric Co.
WSAN, Allentown Radio Club, Allentown, Pa.; 229 meters, 10 watts.
WSAP, New York City; Seventh Day Adventist Church.
WSAQ, Round Hills Radio Corp., Dartmouth, Mass.; 280 meters, 100 watts.
WSAR, Doughty & Welch Elect. Co., Fall River, Mass.; 254 meters, 10 watts.
WSAT, Plainview Elect. Co., Plainview, Texas; 268 meters; 20 watts.
WSB, Atlanta, Ga., Atlanta Journal.
WSL, Utica, N. Y., J. & M. Elec. Co.
WSY, Birmingham. Ala., Alabama Power Co.
WTAB, Fall River Daily Herald, Rail River, Mass.; 248 meters, 10 watts.
WTAC, Johnstown, Pa., Penn. Traffic Co.
WTAS, Elgin, Ill; 275 meters, 500 watts; Chas. E. Erbstein.
WTAU, Tecumseh, Neb., Ruegy Battery & Elec. Co.
WTAW, College Station, Texas; Ag'c'ltle & Mech. College; 254 meters; 50 watts.
WTG, Manhattan, Texas, Kans. State Agri. College.
WTP, Bay City, Mich., Ra-De Corp.
WVP, New York, N. Y. Signal Corps, U. S. Army.
WWAC, Waco, Tex; 3000 miles; Weather forecaste 11 a m daily; musical concerts, daily, 1:30 p m and on Wednesday and Saturday evenings at 8; Sanger Bros.
WWAD, Philadelphia, Pa., Wright & Wright, Inc.
WWAX, Laredo, Texas, Worman Bros.
WWB, Daily News Print Co., Canton, Ohio; 268 meters, 200 watts.
WWI, Dearborn, Mich., Ford Motor Co.
WWJ, Detroit, Mich., Evening News.

(Continued on next page.)

Complete Corrected List of U. S. and Canadian Broadcasting Stations

Canadian Stations

CFAC, Calgary, Alta., Can. Western Radio Co., Ltd.
CFCA, Toronto, Ont., Can. Toronto Star.
CFCB, Vancouver, B. C., Can. Marconi Co.
CFCE, Halifax, N. S., Can. Marconi Co.
CFCF, Montreal, P. Q., Can. Marconi Co.
CFCH, Iroquois Falls, Ont., Can. Abitihi Power & Paper Co.,, Ltd.
CFCI, Walkerville, Ont., Can. Motor Products Corp.
CFCN, Calgary, Alta., Can. W. W. Grant Radio, Ltd.
CFCX, London, Ont., Can. The London Advertiser.
CFPC, Fort Frances, Ont., Can. International Radio Develop. Co.
CFTC, Toronto, Ont., Can. The Bell Telephone Co.
CFYC, Vancouver, B. C., Can. Victor Wentworth Odium.
CFZC, Montreal, Que., Can. Can. Westinghouse Co., Ltd.
CHBC, Calgary, Canada. W. W. Grant Radio, Ltd. (Morning Albertan.)
CHCA, Vancouver, B. C., Can. Radio Corp. of Vancouver, Ltd.
CHCB, Toronto, Can. Marconi Co.
CHCC, Edmonton, Alta., Can. Can. Westinghouse Co., Ltd.
CHCF, Winnipeg, Man., Can. Radio Corp. of Winnipeg, Ltd.
CHCQ, Calgary, Alta., Can. Western Radio Co., Ltd.
CHCS, London, Ont., Can. London Radio Shoppe.
CHCX, Montreal, Que., Can. B. L. Silver.
CHCZ, Toronto, Ont., Can. Globe Printing Co.
CHOC, Vancouver, B. C., Can. Can. Westinghouse Co., Ltd.
CHVC, Toronto, Canada. Metropolitan Motors Co.
CHXC, Ottawa, Ont., Can. J. R. Booth, Jr.
CHYC, Montreal, Que., Can. Northern Elec. Co.
CJBC, Montreal, Que., Can. Dupuis-Freres.
CJCA, Edmonton, Alta., Can. Edmonton Journal, Ltd.
CJCB, Nelson, B. C., Can. James Gordon Bennett.
CJCD, Toronto, Can., T. Eaton, Co.
CJCE, Vancouver, B. C., Can. Vancouver Sun.
CJCF, Kitchener, Ont., Can. Newa Record, Limited.
CJGG, Winnipeg, Canada. Manitoba Free Press.
CJCH, Toronto, Ont., Can. United Farmers of Ontario.
CJCI, St. John, N. B., Can. McLean, Holt & Co., Ltd.
CJCN, Toronto, Ont., Can. Simons, Agnew & Co.
CJCS, Halifax, N. S., Can. Eastern Telephone & Telegraph Co.
CJCY, Calgary, Alta., Can Edmund Taylor.
CJGC, London, Ont., Can. London Free Press.
CJNC, Winnipeg, Man., Can. Trihune Newspaper Co.
CJSC, Toronto, Ont., Can. Evening Telegram.
CKAC, Montreal, Can. La Presse.
CKCB, Winnipeg, Man. Can. T. Eaton Co., Ltd.
CKCD, Vancouver, B. C., Can. Vancouver Daily Province.
CKCE, Toronto,Ont., Can. Can. Ind. Telephone Co.
CKCK, Regina, Sask., Can. Leader Pub. Co.
CKCR, St. John, N. B., Can. Jones Elec. Radio Co., Ltd.
CKCS, Montreal, Que., Can. The Bell Telephone Co.
CKCZ, Toronto, Ont., Can. Westinghouse Co., Ltd.
CKKC, Toronto, Ont., Can. Radio Equipment & Supply Co., Ltd.
CKOC, Hamilton, Ont., Can Wentworth Radio Supply Co., Ltd.
CKQC, London, Ont., Can. Radio Supply Co.
CKZC, Winnipeg, Man., Can. Salton Radio Eng. Co.

Radio in War

International rules for the control and operation of radio in time of war, as propounded by the Commission of Jurists at The Hague, were announced by the Department of State recently.

These regulations, in the preparation of which Captain Samuel W. Bryant, United States Navy, and Colonel George S. Gibbs, United States Army, assisted American Commissioners Moore and Washburn, provide substantially that in time of war the working of non-telligerents radio stations shall continue bo be organized, as far as possible, in such manner as not to disturb the services of other radio stations. Belligerent and neutral powers may regulate or prohibit the operation of radio stations within their jurisdiction.

The erection or operation by a belligerent power of radio stations within neutral jurisdiction constitutes a violation of neutrality on his part as well as on the part of the neutral power.

A neutral power need not restrict or prohibit the use of radio stations located within its jurisdiction, except to prevent the transmission of information destined for a belligerent concerning military operations and except as further prescribed. All restrictive or prohibitive measures taken by a neutral power shall be applied impartially by it to the belligerents.

Belligerent mobile radio stations within a neutral state must abstain from all use of their radio apparatus. Neutral governments are bound to prevent such use.

The transmission by radio by a vessel or an aircraft, whether enemy or neutral, when on or over the high seas, of military intelligence for the immediate use of a belligerent is deemed a hostile act and will render the vessel or aircraft liable to be fired upon. A neutral vessel or neutral aircraft which transmits, when on or over the high seas, information destined for a belligerent concerning military operations shall be liable to capture. The Prize Court may condemn the vessel or aircraft, if it considers that the circumstances justify condemnation. Liability to capture of a neutral vessel or aircraft on account of the acts referred to is not extinguished by the conclusion of the voyage or flight on which the vessel or aircraft was engaged at the time, but shall subsist for a period of one year after the act complained of.

In case a belligerent commanding officer considers that the success of the operation in which he is engaged may be prejudiced by the presence of vessels or aircraft equipped with radio installations in the immediate vicinity of his armed forces or by the use of such installations therein, he may order neutral vessels or neutral aircraft on or over the high seas; to alter their course to prevent their approaching the armed forces under his command; or to not make use of their radio transmitting apparatus while in the immediate vicinity of such forces.

A neutral vessel or aircraft, which does not conform to such direction, exposes itself to the risk of being fired upon. It will also be liable to capture, and may be condemned by the Prize Court.

Neutral mobile radio stations shall refrain from keeping any record of radio messages received from belligerent military radio stations, unless such messages are addressed to themselves. Violation of this rule will justify the removal by the belligerent of the records of such intercepted messages.

Belligerents are under obligations to comply with the provisions of international conventions in regard to distress signals and distress messages so far as their military operations permit. Nothing in these rules shall be understood to relieve a belligerent from such obligation or to prohibit the transmission of distress signals, distress messages and messages which are indispensable to the safety of navigation. The perversion of radio distress signals and distress messages prescribed by international conventions to other than their normal and legitimate purposes constitutes a violation of the laws of war and renders the perpetrator personally responsible under international law.

Acts not otherwise constituting espionage are not by reason of their involving violation of these rules. Radio operators incur no personal responsibility from the mere fact of carrying out the orders which they receive in the performance of their duties as operators.

How to Ship

At a general meeting of the Electrical Jobbers' Association, held at Hot Springs, the following recommendations were presented by the Radio Committee, and unanimously adopted by the Association:

That manufacturers of radio materials supply their distributors with standard size, 8 1-2 by 10 inch price and data sheets.

That defective tubes and radio materials returned to manufacturers, where such returns are permitted, be credited rather than replaced in the interest of economy by the elimination of handling small shipments, as in most cases the distributor has already made replacement or adjustment with the dealer.

That manufacturers pack and ship receiving sets in individual cartons or crates of sufficient strength to permit reshipment in original package.

That all manufacturers of receiving sets of value of $25 or more, supply these sets with a serial number to facilitate the tracing of lost or stolen sets, and that the serial number and catalog number appear on the outside of the container where it will show to the best advantage in stocking on distributors' and dealers' shelves, and further recommends that manufacturer, distributor and dealer use serial numbers on their invoices.

That all portions of inside of instruments depending on the strength of the panel for support be reinforced by extra individual support of such unit so mounted to prevent breakage by rough handling.

That the present practice of alloting radio materials on which the demand exceeds the supply be changed to conform to the practice of manufacturers of other lines handled by distributors, thereby rewarding the distributors who create business and placing supplies where the demand is most urgent and with a view to discouraging speculation.

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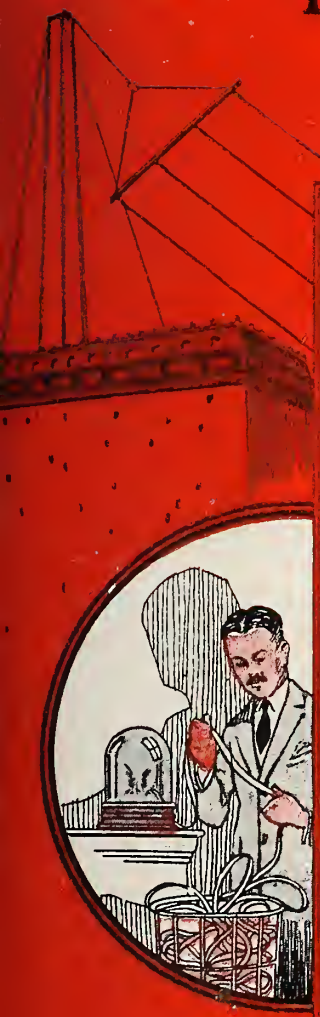
RADIO AGE

The Magazine of the Hour

Price 25 cents

SEPTEMBER, 1923



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By Frank D. Pearne

How to Make a Simple Radio Frequency Receiver
By Felix Anderson

How Radio Invaded the Arctics
By E. F. McDonald, Jr.

Complete Corrected List of Broadcasting Stations

More Good Circuits

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RADIO AGE

The Magazine of the Hour

Volume 2 *SEPTEMBER, 1923* *Number 8*

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Looking Ahead

IN THE August number we promised to publish a feature in the present issue that would interest every radio fan. We refer to the article written by Mr. Pearne on the effect of the new wave lengths allocated to stations in the United States and how fans may adjust their receivers to meet difficulties caused by the change. This illustrated article will answer large numbers of letters from fans who desired information on this new situation in radio.

Illustrated information on several important circuits is in preparation for the October number. We have no doubt that readers have noticed that technical articles in Radio Age are written by our own experts. Radio Age does not "borrow" its text or its illustrations from any other publication. We are publishing a magazine for the readers and we want readers to ask for what they want.

Questions are answered in our "Trouble Shooter" department and the greatest of care is devoted to the writing and illustration of the answers. For non-subscribers who wish immediate assistance through the mail, with hook-up sketch, a nominal service charge of 50 cents is made. For answers published in the magazine no charge is made. It is your department. Use it.

Send in your letters about radio experiences. They will interest other fans. Write and tell us what you like most in a radio publication. We are building for the future as well as enjoying the present.

To the thousands of new readers whom we greet in this issue we want to say that they are welcome additions to our big swarm of bugs.

Give us a buzz.

—The Editor.

Here is a picture of Dr. Donald B. MacMillan, the Arctic explorer, as he looks in the radio room of his doughty little vessel, the "Bowdoin." The ship is equipped with powerful radio apparatus and for the first time is carrying into the land of vast silences a means of constant communication with the home country. Radio has thus eliminated one of the greatest difficulties attending explorations in the polar regions—lonesomeness and maddening silence. Read the article by E. F. McDonald, Jr., on page 9.

RADIO AGE
"The Magazine of the Hour"
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FREDERICK SMITH, EDITOR

How the New Wave Allocations Affect the Receiver

By FRANK D. PEARNE

ON THE fifteenth of May, a change was made in the allocation of wave lengths to be used by the various broadcasting stations in the United States. This change was recommended by the National Radio Conference and approved by Secretary Hoover. This has resulted in a rather peculiar condition, so far as the broadcast listener is concerned. Many of us were astonished to hear stations which formerly came in just fairly well, suddenly become quite strong and on the other hand, some of the old reliable stations which could always be depended upon to give plenty of volume, dropped so far below standard that reception of any kind was quite difficult. Why all this confusion?

Formerly all broadcasting was done on a wave length of from 360 to 485 meters. Under the new arrangement this band was changed to from 222 to 545 meters. It will be noted that the increase in length only amounted to sixty meters, but the change in the downward direction amounted to 138 meters. In other words, the wave band has been broadened to a considerable extent and most of the receiving sets in use today are not equipped with the proper apparatus to cover this wide range.

The question now arises, "Why were they not made so that they would cover a wide range?" The answer is quite simple. Unless special apparatus is used, the wider the range of a set, the less the efficiency will be on any one particular wave length. The average set in use today will cover a wave band of from 200 to 450 meters. It is possible, of course, to hear a station slightly outside of this range, but the reception is poor, due to the fact that the set can not be tuned in perfect resonance, or harmony, with the incoming wave.

Apparently there will be no difficulty in getting down to the 222 meter end of the scale, but the thing which most concerns us is how to raise the wave length far enough to get the stations working on the high end of the scale. This will call for an additional raise of sixty meters, which is not a great change, but very necessary if we wish to get all the good things going on the air. This slight change may be accomplished without any great loss in efficiency, by loading the different circuits of the set.

First of all, however, some attention must be paid to the aerial. Every aerial has a certain fundamental wave length, which is determined by its inductance and capacity. For example, let us refer to a single wire aerial of not more than 100 feet in length, or rather 100 feet from the extreme end to the point where it is connected to the ground, after passing through the set. The most simple method of calculation is to multiply the length in feet by the constant 1.44, which will give the approximate wave length in meters. This, of course, is not absolutely accurate and does not take into consideration the inductance used in the primary circuit of the receiver, but it is sufficiently accurate to give some definite idea as to whether or not results should be expected. Such an aerial as mentioned would have approximately a fundamental wave length of 145 meters.

Now, when it is connected through

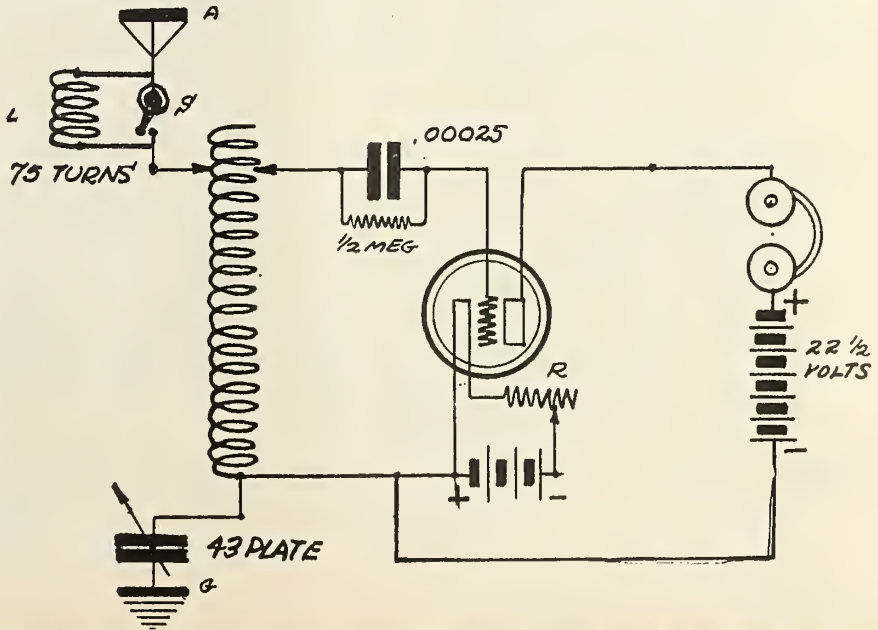

Figure 1. The single circuit receiver is loaded by inserting a seventy-five turn coil in the antenna circuit and placing a 43-plate condenser in the ground lead.

the set, considerable inductance is added to its natural inductance, which would greatly increase its wave length. If the primary inductance of the set is the stationary winding of a variocoupler, then the switch contacts provide a means of changing the inductance of the aerial circuit. If only a few turns are cut in by the switch, then very little inductance will be added to the fundamental inductance of the aerial and the wave length will be a little more than the fundamental wave length of the aerial, but if all the turns are cut in, then the inductance is greatly increased and the wave length is also greatly increased. Any way we know that we can cut the wave length down to just a little more than the natural wave length of the aerial and we can raise it to any point depending upon the inductance which we cut into its circuit.

Before the change of wave length went into effect, most of the variocoupler primary, or aerial coils, were wound with from forty to sixty turns, which when used in connection with a large aerial, would be sufficient inductance to receive the new wave lengths; but if the aerial is small, having a short fundamental wave length, then this winding is not enough and more turns will be necessary to increase the wave length to the desired point. These extra turns need not be on the primary of the coupler and if placed anywhere in the aerial circuit, the result will be to add inductance and any changes in this may be accomplished by regulating the turns on the coupler by means of the switch.

An arrangement of this kind will take care of increasing the wave length of the receiver. But what happens to the fellow who has such a large aerial that the long waves come in but on account of its size, he cannot cut it down below 300 meters? In this case, the fundamental wave length of his aerial is so high, that it is some where near 300 meters and adding inductance will only increase it. This can be taken care of very nicely by adding a condenser to the aerial circuit. This should be cut into the circuit, somewhere between the aerial and ground.

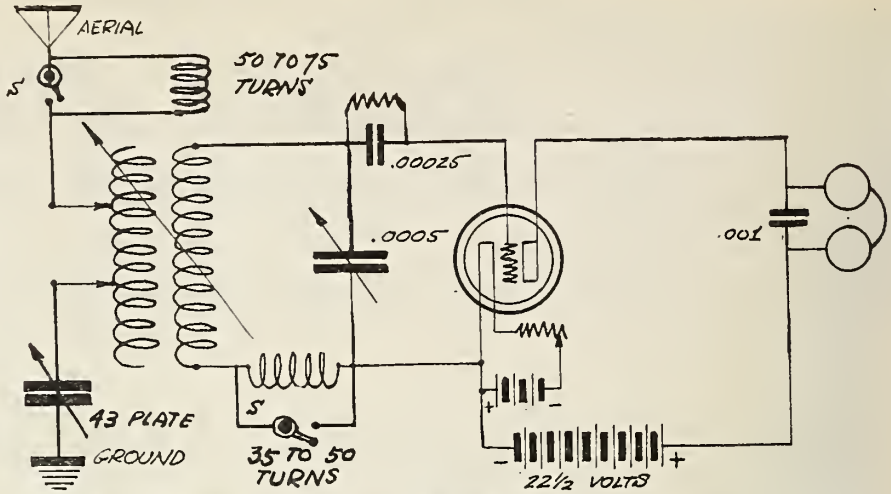

Figure 2. The two-circuit tube set is loaded by the addition of two coils placed in the antenna and grid return circuits. Switches are provided to cut out the coils if desired

A variable vernier condenser should be used for this purpose, its capacity depending upon how much the wave length is to be lowered. Generally, a 43-plate condenser, which varies from nearly zero to .001 M. F. is used for this purpose and the best point to place it is between the set and the ground. The reason for this location is that when so placed the movable plates may be connected to the ground, which will cut down the body capacity effect when trying to tune very close. Thus we see that by using either inductance, or capacity in the aerial circuit, we can conform the fundamental wave length of any aerial to meet our requirements.

So far as a single circuit receiving set is concerned, this is all that is necessary; but for those who are using the double circuit type, or three circuit arrangement, we shall have to go farther into details. In sets using more than one circuit, as shown in Figures 2 to 6, these other circuits will also have to be loaded so that they will oscillate in resonance with the aerial circuit. In the double circuit tuner shown in Figure 2, the secondary or rotor of the coupler is connected to the grid circuit. To load a circuit of this kind, the aerial inductance added should be approximately fifty to seventy-five turns. This is shown as "L" in the drawing. The inductance "L1" should be thirty-five to fifty turns. Ordinary honeycomb coils may be used for this purpose, or the coils may be made at home by winding the proper number of turns on a four-inch cardboard tube. The coil used in the

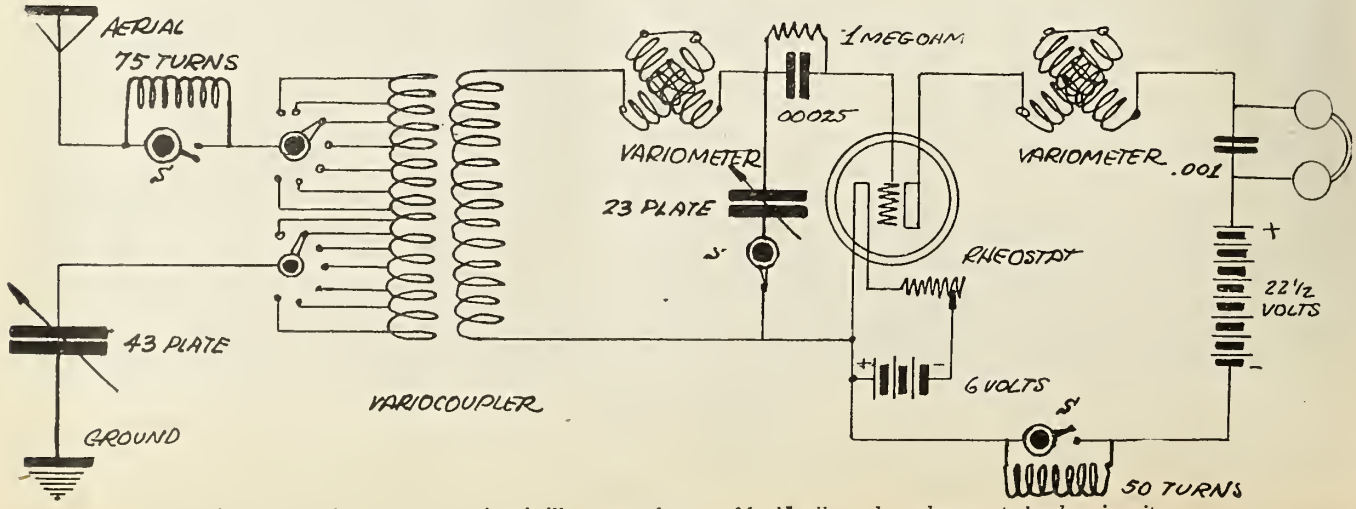

Figure 3. The Armstrong circuit illustrates the use of both coils and condensers to load a circuit.

aerial circuit of Figure 1 (the single circuit set) should have seventy-five turns and may be constructed in the same way. Condensers may, or may not be used in these aerial circuits as shown, but as they serve so well in obtaining a close adjustment, it is well to use them if it can be done without requiring too much added inductance. In the standard Armstrong regenerative circuit shown in Figure 4, the variometers give a change in wave length which usually amounts to a change of 240 to 250 meters, which is generally enough to take care of the secondary and plate circuits, however, in some cases it has been found necessary to add a 75-turn inductance in the aerial circuit, and a 50-turn coil in the plate circuit.

A 23-plate condenser shunted across the grid variometer and the filament circuit as shown, will raise the wave length of the grid circuit. This application of the condenser should not be confused with that of the aerial condenser as in the case of the aerial it is in series, and in this case it is in parallel.

The Reinartz tuner is the most difficult of all to load for longer waves. In his original specification, Mr. Reinartz used a coil of 70-turns for this purpose. An extra contact was added to the aerial and grid switches. These contacts were located on the left-hand end of the aerial switch and the right-hand end of the grid switch. The ends of the coil were connected to these two contacts and at a point twenty turns from the grid contact connection the coil was grounded, as shown in Figure 4. As this required considerable changing in the panel

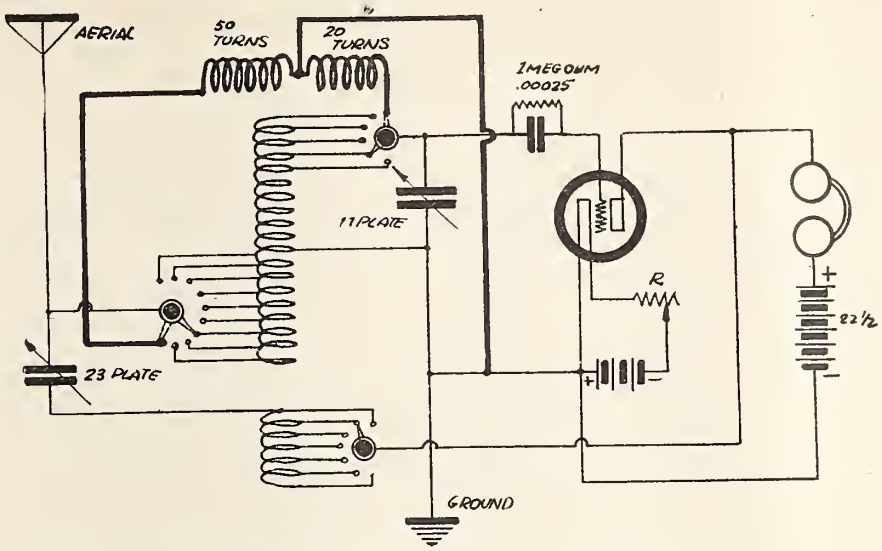

Figure 4. Showing the loading arrangement of the Reinartz circuit.

arrangement, some of our readers have had excellent results by simply adding a 75-turn coil in the aerial circuit and a 50-turn coil between the grid switch and the rest of the grid circuit. This is a matter of experiment, as most Reinartz sets were built by the user and in a number of known cases, the switches advance in the opposite direction to that given in the original specifications, which would make a difference in the location of the extra switch contacts.

Figure 5 shows the ultra audion circuit. To raise the wave length of this circuit it is only necessary to add a 75-turn coil between the variometer and grid connections as shown. In the case of the three-coil honeycomb set, shown in Figure 6 the standard windings consist of coils having 35, 50 and 75 turns

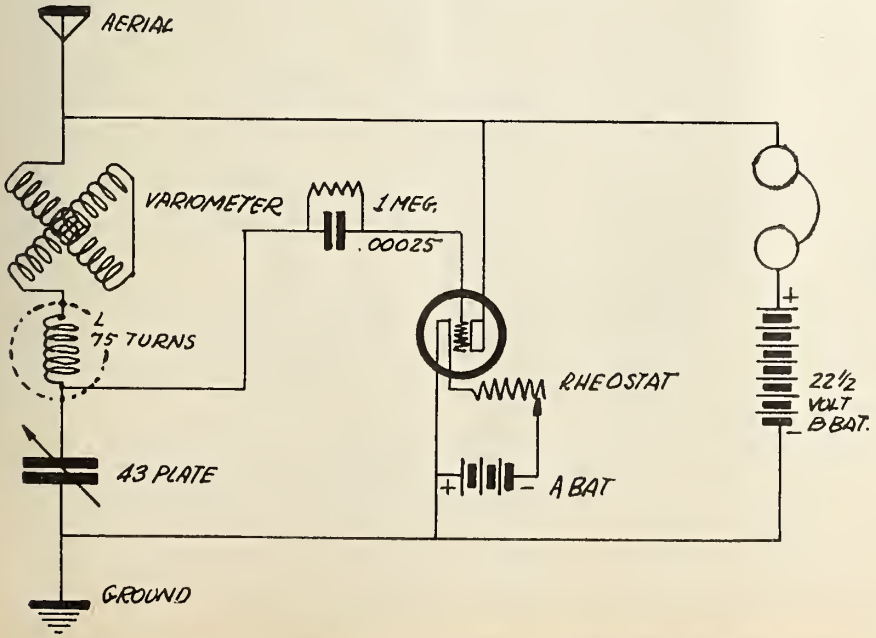

Figure 5. The only additional apparatus used to increase the wave length range of the Ultra Audion circuit is a 75-turn coil placed in the antenna circuit.

wave lengths it is only necessary to procure an additional honeycomb coil having 100 turns. Use the 50-

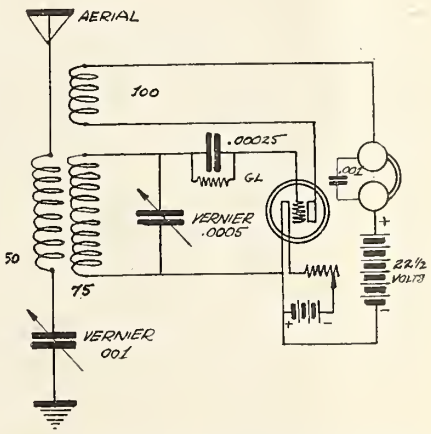

Figure 6. The use of larger honeycomb coils in the honeycomb circuit will increase the wave length of this set.

and to change this over to the new turn coil in place of the 35; the 75 in place of the 50; and use the 100 where the 75 was formerly used. In adding these coils to circuits 1 to 5, it is a good plan to arrange them with a short circuiting switch, by means of which they may be cut in or out of the circuit at will. If desired these coils may be made with taps, which can be connected to switches on the panel, allowing changes to be made in the value of these added inductances, thus securing just the right balance of the different circuits. This is a great help in procuring both tone and volume.

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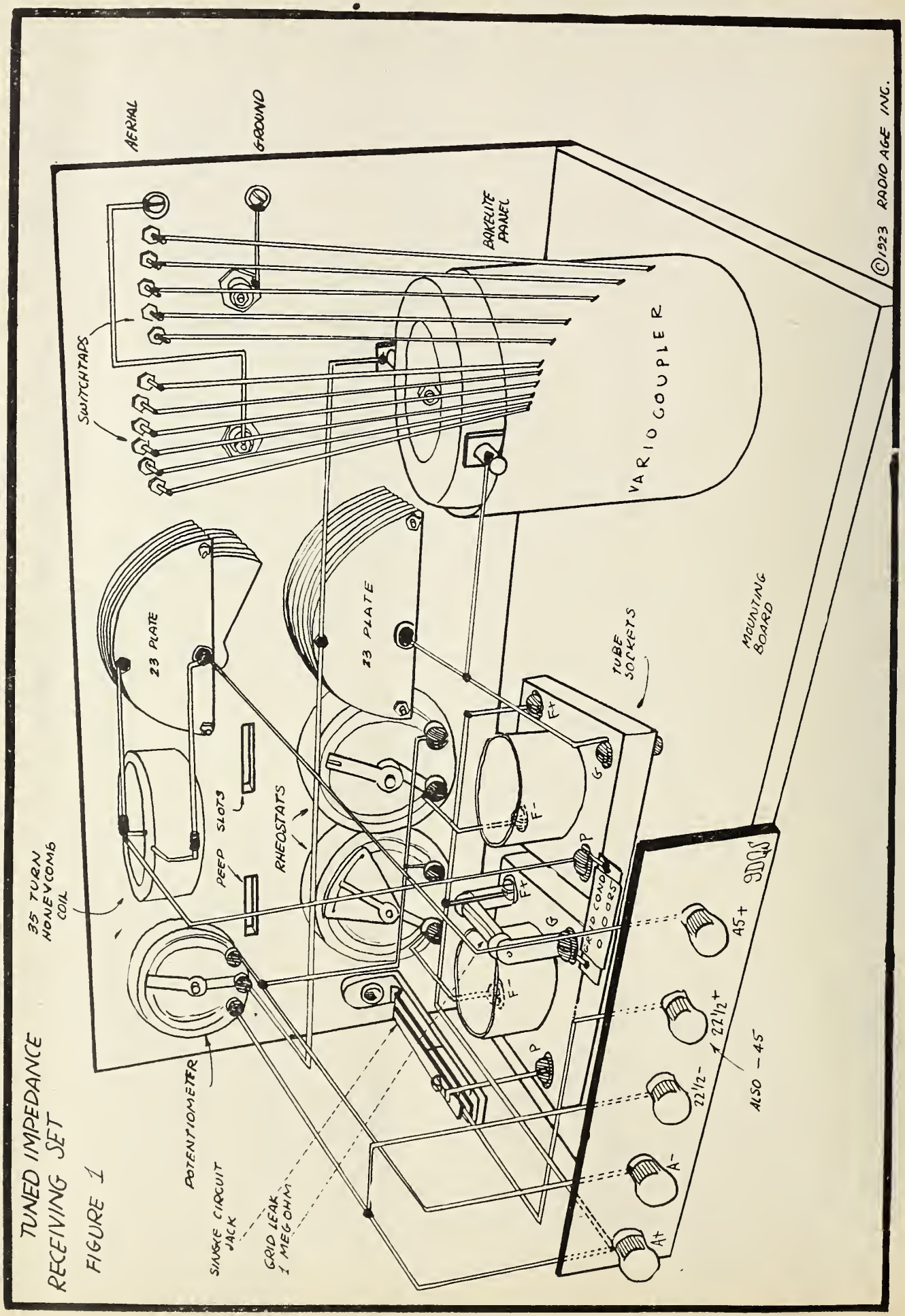
Don't miss the great subscription offer described on the back cover of this issue. The rate positively will be withdrawn on October 1, 1923. Write now.



TUNED IMPEDANCE RECEIVING SET

FIGURE 1

How to Make a Simple Radio Frequency Receiver

By Felix Anderson

Radio 9 DQS

THIS magazine has incorporated in the course of its policy of radio instruction, and presented to its readers a series of tube circuits dealing largely with new and unique arrangements of the various components of circuits, and as yet has not given detailed instruction relative to the building and design of a radio frequency amplifier. Many of our readers are probably interested in a receiver of this kind.

Radio frequency amplification is a delicate radio problem, and as a rule requires the use of delicate transformers, accurate condensers, and carefully computed inductances. Due to this obstruction, the technical department of RADIO AGE has taken a conservative point of view on the subject. Until recently this type of amplification was the subject of experimentation by leading radio engineers and the rank beginner must not be misled into believing that a radio frequency amplifier is a simple thing to construct.

Radio frequency amplification is the amplification of a radio frequency oscillation prior to its being detected and recorded. This may sound a bit technical to the average reader, but is easily explained.

It is generally conceded that the average human ear cannot register sounds above frequencies of 10,000 cycles per second. This is called audio frequency. There are some rare exceptions to this rule but it is arranged by experts as a convenient dividing point, classifying it from radio frequency which applies to frequencies of 10,000 and up. Radio signals being of radio frequency nature, therefore are inaudible to the human ear. This explains the use of crystals, tubes and other rectifiers used to change them to frequencies audible to our sluggish ears.

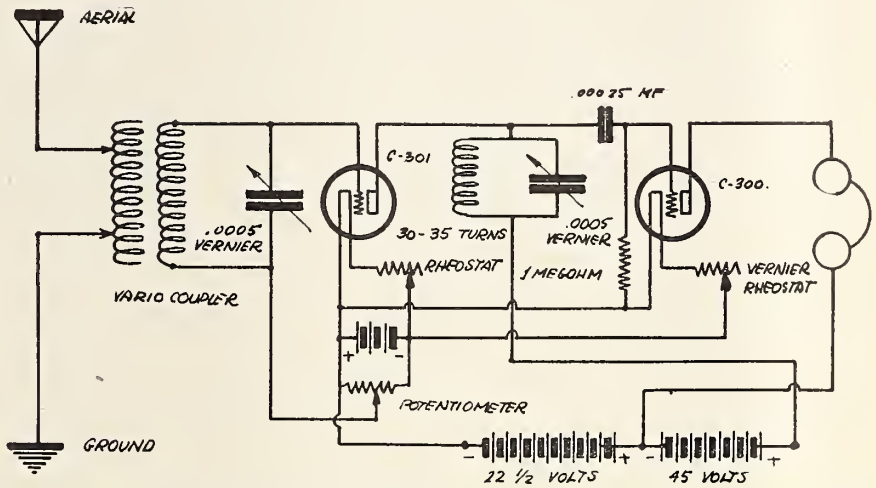
In radio we generate these oscillations at a transmitting station and transfer them at various frequencies to the transmitting antenna where, according to the general belief, they produce pulsations of corresponding length in the ether.

We erect aerial systems to intercept and retransfer these oscillations or ripples into our receiving sets which, providing they are properly designed and adjusted, will rectify and record them.

These feeble currents, collected by our antenna systems (still of radio frequency nature) travel along the aerial and lead-in wires until they reach the receiving instruments.

Here is where the change takes place.

The popular method is to transfer these oscillations or signals directly to the rectifying component of the set. Usually we find them very feeble pulsations, especially if they are generated by some distant transmitter, and even though they may be intercepted, are lost, due to the fact that they are not of sufficient strength to make a tangible change in our rectifiers, which would permit us to hear them.



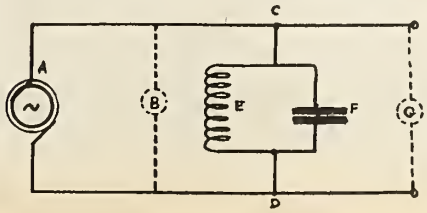
Suppose we had an arrangement with which we could amplify these feeble pulsations to a value where they would be impressed upon our detectors at a greater strength than when they were originally intercepted.

This is exactly what is carried out when we use radio frequency amplification.

A circuit diagram of a set which will efficiently carry out this phase of radio is shown in Figure 2. This circuit, called a tuned impedance receiver, does not use a transformer of the usual type, and its function is widely different, as illustrated in Figure 3.

An alternating current generated at A passes out to the point on the wires at the dotted lines across B. A current measurement is taken at B at a given frequency. Supposing a circuit consisting of an inductance E and a condenser F which is tuned to the same frequency (as when the measurement was taken) is shunted across the circuit at G, at the points C and D. A current reading taken at G will, when compared with the measurement obtained at B, show a greater flow of current.

We apply this principle in the circuit shown at Figure 2. The signal traveling through the aerial and variocoupler primary sets up a current in the secondary. The secondary in connection with the 23-plate variable condenser forms an oscillatory circuit similar to that shown in Figure 3. The condenser is adjusted until the circuit is in resonance with the incoming oscillation.



True to the foregoing principle it is amplified by this first circuit. The amplified oscillations are carried on to the first vacuum tube where they are further amplified by the action of the tube and are again amplified when they are carried to the second tuned circuit, consisting of a 23-plate condenser and a 35-turn honeycomb coil, connected to the plate of the first valve and the positive B battery.

The signal is then impressed upon the grid of the detector valve with much greater force than if it were introduced using the customary arrangement.

A set of this kind is simple to construct and requires the following apparatus:

Two sets of switchtaps and levers.
One variocoupler.
Two 23-plate vernier variable condensers.
Two rheostats, one with and one without vernier.
One potentiometer, 200 to 400 ohms.
Two tube sockets.
One single circuit jack.
One grid condenser, .00025 Mf.
One grid leak, one Megohm.
One U V or C 300 tube.
One U V or C 301 tube.
One 30 to 35-turn honeycomb coil.
One 22 1-2-volt B battery.
One 45-volt B battery.
Headset, phone plug and storage battery.
Connecting wire, preferably copper bus bar tinned.

(*Continued on page 32.*)

Arctic Radio

Every explorer who returns from a trip to the Arctic regions says that the morale of such an expedition is not broken by the intense cold which prevails in these latitudes, nor the privations, but the awful solitude which is imposed upon the members of such an adventure.

When a party departs on a mission of this kind, it means the cessation of news from the civilized world, and the anxiety for knowledge from home becomes so great as to even break the morale of the most carefully organized expedition.

But this is no longer necessary, as demonstrated by the radio polar expedition, which is led by Dr. Donald B. MacMillan.

The radio phase of this exploration is being carried out by the receiving and transmitting station, better known as WNP—Wireless North Pole, which is to endeavor, through the efforts of its operator Donald H. Mix, to keep in constant touch with the United States.

The qualities of Mr. Mix's radio experience, coupled with the 100-watt transmitter of a very efficient circuit and the Zenith receiver adapted to both long and short waves should certainly insure, if such a thing is possible, reliable communication.

The transmission is to be carried on schedule, but any one hearing this station should report its reception to the American Radio Relay League at Hartford, Connecticut, and the North American Newspaper Alliance, at 63 Park Row, New York City with the detail concerning any such reception.

The schedule of WNP is as follows:—

10 p. m. to midnight WNP will stand by for press reports.

Midnight: WNP will stand by for reports from the government station NSS on a wave length of 17,000 meters.

1 a. m. to 2: 59 a. m., WNP will communicate with amateurs.

3 a. m. to 4: 59 a. m., special communication with designated stations.

5 a. m. to 7 a. m., communication will be carried on with amateur stations.

If any of our readers are so fortunate to hear WNP, this magazine should be glad to acknowledge receipt of such news. Station WNP will transmit on wave length of about 185, 220 and 300 meters according to the demand of the receiving operator with whom communication is being carried on. However 220 will probably be the one most used.

As we go to press, we learn from a letter from Mr. E. F. McDonald, Jr., of the Zenith-Edgewater Beach Hotel Broadcasting station that the expedition has not been heard from since July 28th. Mr. McDonald says however, that there is no cause for anxiety, as the ship Bowdoin is inside the auroral band, and will be in continuous daylight until September. Reception is exceedingly difficult because of low power transmission necessitated by limited daytime shift.

Station WJAZ is presenting gratis to the first Canadian or American amateur to deliver to the Zenith-Edgewater Beach Hotel Station the next message from MacMillian, a complete standard Zenith receiver and amplifier, a duplicate of the instrument supplied to the expedition.

Who will be the first amateur to QSO the Bowdoin?

William Scheney, the one-man orchestra with the instruments of his trade as gathered about the microphone in the radio studio of WGY, the Schenectady broadcasting station of the General Electric Company.

Photograph on the right shows Dr. Donald B. MacMillan in the chart room of the "Bowdoin," the tiny ship now in the Arctic. On the right is a picture of an iceberg as seen from the deck of the Bowdoin. Photographs by courtesy of E. F. McDonald, Jr., of the Chicago Radio Laboratory, who was a member of the adventurous party for some distance into the frozen north. Radio communication with the boat was sustained daily, until July 28.

A Fragment of MacMillan's 1923 Trip to the Arctic

By E. F. McDonald, Jr.

THE elaborate preparation for the MacMillan trip back to the Arctic reached its culmination June 23, when the Bowdoin, trig, trim and smartly arrayed with international code flags, shoved off from Wiscasset, Maine. On board were Dr. Donald B. MacMillan, his crew of six men, a handful of guests, including the two ex-Arctic explorers, General A. W. Greeley and Langdon Gibson, the former the oldest living Arctic explorer and the latter a participant of the early memorable Peary expeditions.

Every man, woman, and child of the town and county were at the dock to wish Godspeed and wave a kerchief of *au revoir*. This group was considerably swelled by many visitors from Maine and notables from different parts of the United States. Long after the seething crowd at the dock became a blur against the dark land background as the Bowdoin sped down the river, we could still hear the shrill voice of a locomotive and the boom of a cannon calling farewells.

The wireless operator on board the Bowdoin kept up constant communication even after we were out of sight with Mr. Maxim, Mr. Warner and Mr. Schnell of the American Radio Relay League, who had erected a temporary Zenith radio receiving apparatus on the pier, and used that not only for receiving but for sending messages over the short distance to the Bowdoin. This sending of messages with a receiving set was accomplished by making the receiving set oscillate and when the antenna switch was touched with the moistened finger, it produced signals so that messages in continental code were readable aboard the ship.

The first stop was at Boothbay, where all visitors, including General Greeley and his daughter, took leave of us. Then we put to sea in earnest and had as our next objective, Monhegan Island. Within the very next hour we ran into a school of enormous black fish, which are a species of whale, some of them ranging forty feet in length. So close did we approach one of these that Tom McCue disturbed it in its peaceful slumber by tossing a can of pemican, which reached its mark.

At Monhegan Island we were cordially received and dined by the inhabitants. Our moving picture photographer bade us good-by here. We saw him tearing off a reel of film as we left him standing on the shore, but the day was misty and not conducive to good pictures.

Clouds of fog enveloped us practically, all the way from Monhegan to Sydney, Nova Scotia. But notwithstanding the impenetrable mist, we crossed the Bay of Fundy, passed Cape Sable and the grave yard of the Atlantic without mishap. During one of the night watches we encountered a mysterious ship which was in our course about one point off our port bow when its lights were sighted, and as we approached extinguished all lights. It had all the earmarks of a warship, but it might have been a rum runner or a Canadian government rum runner chaser.

Here is the crew of the "Bowdoin," sturdy little ice-pusher, that is carrying Dr. Donald B. MacMillan into the far north waters.

Fullfledged sea discipline was in operation on the Bowdoin from the moment the last visitor stepped off the gang plank at Boothbay. The day and night was divided into four watches: six hours on, and six hours off. I had the good fortune to be in the watch in charge of Captain MacMillan and the Chief Assistant, Ralph Robinson. The other watch was in charge of the mate, Thomas McCue. Breakfast at six, dinner at noon, supper at six, with a "mug up" at midnight.

Since my return I have been frequently asked for a description of the layout of the Bowdoin. I might as well sandwich that in at this point. Although frequently stated before, the length of the ship bears repeating, for the ship's size should be borne in mind, to appreciate the extraordinary economy of space and the wonder of cramming the restricted cubic area with provisions and equipment to last for years. Not only is every available inch of space below decks used, but the main deck is crowded with barrels and barrels of fuel and lubricating oil, and miscellaneous provisions of an imperishable nature. The ship is not more than eighty-nine feet over all. The forecastle, galley, and radio room make up the forward end of the ship.

It is the smallest ship that ever ventured an Arctic expedition. The hold or storage space is amidships; back of this, the engine room; the captain's quarters, aft. The largest compartment is the forecastle, comprising the radio room, living and sleeping quarters of the crew, and the galley. The radio room is in the peak of the forecastle, the berths for six men along the sides, the mess table in the center, and the galley in the after end of the forecastle. When the radio starts sending, as it usually does between midnight and 3:00 it makes as much noise as a locomotive would, running up and down the passageway of the forecastle.

The first night, the cook arose in great consternation believing bedlam had broken loose. He rubbed his eyes furiously and finally discovering the source of the disturbance, drawled in his quaint way, "Well, I have been shipmates with a lot of things, snorers, etc., but never with anything as noisy as that animal." Strange to relate, the crew no longer hears the noise of radio sending. After a few days' companionship we were used to the noisy stranger and slept undisturbed.

The hold is loaded so full of provisions, it was with difficulty that the hatch was battened down. Filled not only with food and provisions but with dolls, clothing, knick-knacks, and Brunswick phonographs to be presented to the Eskimos of the most northerly tribes. The engine room is a solid mass of machinery, every inch of space being utilized. Its four walls are enormous fuel tanks of kerosene which give this ship the greatest cruising range of any small ship in the world. The enormous fuel supply is needed when one considers that for days and days with the engine running full speed the ship, which normally makes nine knots per hour, makes

Donald Mix, famous radio operator, who is in charge of the radio equipment on the little ship "Bowdoin." U & U foto.

less than nine knots per day, trying to forge ahead while pushing against the ice.

In the forward end of the engine room are two 3-4 kilowatt Delco generators and two complete sets of thirty-two volt storage batteries. At present one generator and set of batteries is being used to light the ship and the other generator and batteries for the radio. Tremendous power is consumed by the radio in hurling forth its wireless messages back to civilization.

The captain's quarters, of which I have an excellent picture, are very small and compact. Two berths, one Dr. MacMillan's and the other that of his chief assistant, doctor, photographer, general handyman, etc., Ralph Robinson. In the middle of the cabin stands the captain's chart table with its chart rack and navigating instruments. Lining the upper walls is a very complete library of scientific books. The forward wall presents the scene of an arsenal with at least twenty rifles, running in calibre from the small 22, equipped with Maxim silencer, to the large 401 calibre, bear and walrus rifles.

Small side arms have no place on this expedition. As a matter of fact, there is only one revolver on the ship, which is owned by Richard Goddard, the representative of the Carnegie Institute of Washington, who explained to me that he carried it only for protection while away from the ship, making his observations in terrestrial magnetism. On the back wall of the captain's quarters are fastened two delicate chronometers, which are checked by Arlington wireless time each day. For this purpose there has been an extension wire run from the Zenith receiving set in the forward end of the ship to a position directly alongside the chronometer, which incidentally is also directly alongside the head of the captain's berth. While the extension was primarily for setting the chronometers, it is used many nights by the captain, lying in his berth between watches, to listen to the radio concerts going on in the forecastle.

The captain's quarters are heated only by a small oil stove, which does nothing in the extreme cold but raise the temperature slightly. The forward end of the ship is heated by the galley shipmate range, which is now burning coal, but as soon as the supply is exhausted (not very long), will be equipped with oci-gas burners, to utilize the kerosene fuel intended for the engine. This year the fuel of the ship has two drains which it did not have on expeditions heretofore: heating and cooking, and the radio.

So much for the ship equipment.

Sydney was the next stopping place. Anchor was dropped at North Sydney the first night because of the heavy fog. Next day found the Bowdoin gracefully gliding into Sydney harbor amid the roar of salutes from the French gunboat Regulus, anchored in the harbor. At first the cannonading worried us, because we had heard the night before of a strike waging in the coal mines and steel mills; of Canadian troops moving in; and of increasing threatening trouble. But our doubts soon gave place to delight over the warm reception and extreme courtesy of which the cannonading was the first evidence. The guns were not turned towards us. This was July 1. I shall never forget it. What a thrill it gave as I saw the American, Canadian, and French flags flying from the Royal Sydney Yacht club, and public buildings and from private residences. Such was the interest shown in the MacMillan exploration trip on the national holiday of the Canadians. As everywhere else we were showered with attention here. Worth mentioning is the fact that Sydney is the outpost of civilization and was the last place on the trip showing signs of modern day progress. It was here that Dr. MacMillan had his last ice cream cone. I caught him in the act with my camera, as a very good picture gives abundant proof.

Leaving Sydney we headed northeast through a dense fog and caught only a glimpse of Newfoundland as we passed by. This was Port-Aux-Basques. Fog whistles blew at other points along the Newfoundland shore, but only at the one point did the fog lift its veil long enough to permit a view. Likewise most of the Coast of Labrador remained a mystery to us. Often we thought land directly ahead, but as we approached the dim outline of the supposed land there was gradually revealed the form of an iceberg. So many icebergs strewed the way traveling was exceedingly dangerous.

Our first stop in Labrador was in back of Greeneley Island, at night and under cover of fog. Next morning when the sun rose, about 3:00, a. m. we found ourselves within a hundred yards of shore. Were it not for the wonderful navigating of Dr. MacMillan, we would many times have been piled on the rocks along that formidable Labrador shore. Dr. MacMillan made this stop to visit and examine Paraquet Island, which is a rookery of the puffin. These puffins are known as the "parrots of the Arctic," are wonderfully colored, have the characteristic parrot bill, but feed on fish. Millions of them swarm the island which is no more than one mile square.

A walk on the Island disclosed the tundra formation, undercut and tunneled by puffins' nests in countless numbers. The puffins are so tame that they posed in front of our camera, but invariably

(*Continued on page 22.*)

W R C Goes On the Air

Washington, D. C.—At three minutes past eight on August 1, announcer Cross of WRC told the waiting fans that a new voice, the voice of the Capital, was about to speak. Presently the new 500-watt station of the Radio Corporation began its initial program on 469 meters. It was a comprehensive evening's entertainment from the appropriate prayer of Chaplain Scott of the Navy to the final number by the U. S. Marine Band at 11: 00 p. m.

Officials of the Corporation and the Government spoke of the station's future and the development of radio as a public utility available in peace and war.

Rarely has a more graphic recital of the romance of radio been offered than the following address by Assistant Secretary S. B. Davis of Commerce Department and Chairman of the Interdepartmental Radio advisory committee.

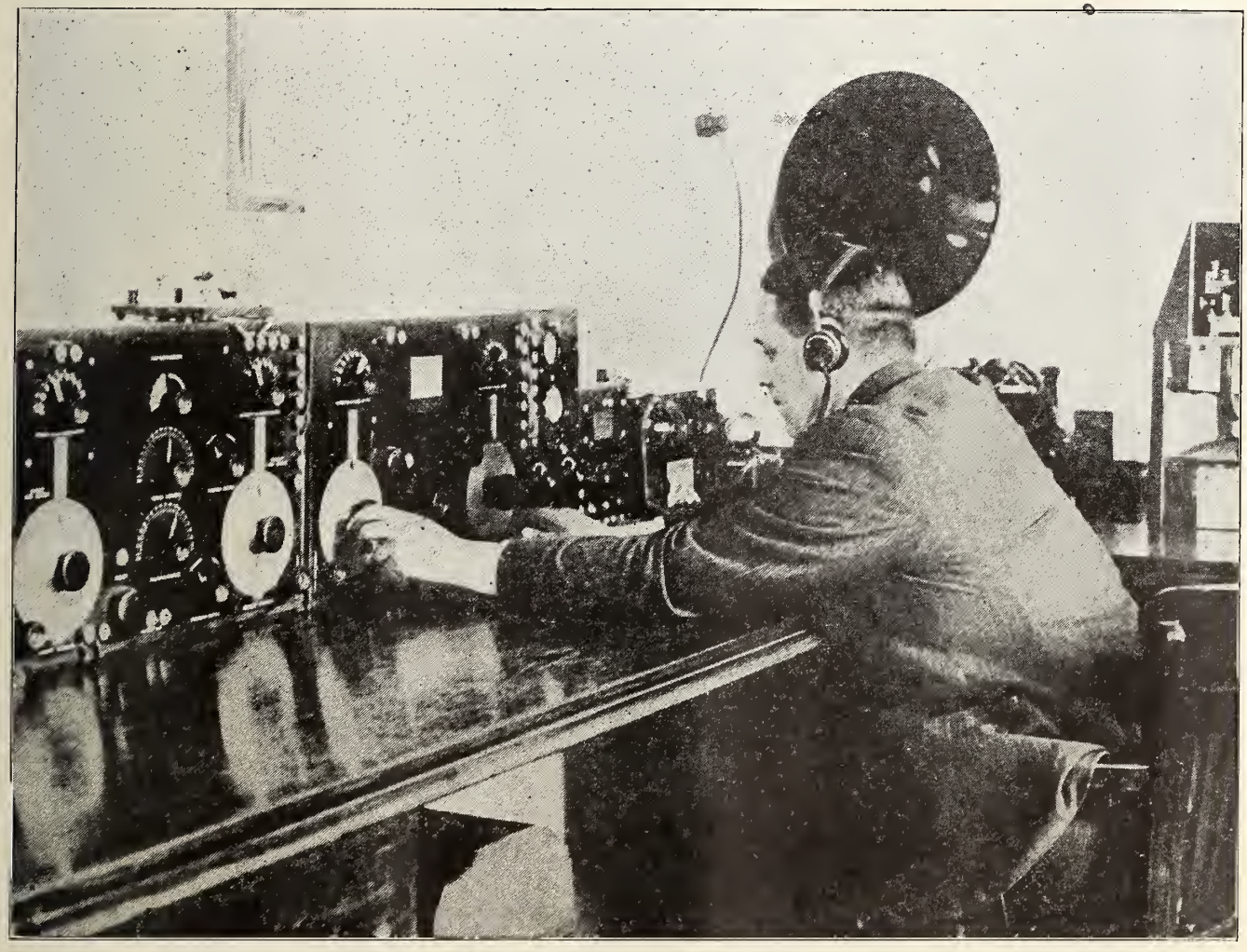
"We meet tonight to welcome the youngest member of the radio family, which is to devote its life to what we now call "broadcasting," an activity so now that the word itself, in its present significance, was unknown only a few years ago. The family has been of rapid growth, but it is not of the mushroom type, to flourish but a moment and then perish. We who listen nightly to the messages that entertain and instruct us accept them more or less as a matter of course, without much thought of either their mystery or their novelty; but no prior discovery has ever seized the public mind and sprung so rapidly into general popular use as has radio.

"The first license authorizing a station to broadcast was issued in September 1921, less than two years ago. Tonight, with the entry of this latest station into the field, there are five hundred sixty-seven stations in this country authorized to broadcast. Born in the United States, broadcasting has largely retained its Americanism. Foreign countries have adopted its English name into their language. In all the rest of the world there are only sixty-three such stations, and of these, thirty are in Canada, our nearest neighbor. How many people receive their messages no one knows, but in our country alone they are numbered by the million. Never since the first letter was printed from moveable type has such a huge stride been taken to make information freely available and to put knowledge and education within the reach of all.

"Since the day when the savage sent his messages by signal fires and beating drums man has been striving to conquer distance. He has dotted the earth with his railroads and automobiles and the sea with his ships in his effort towards the more speedy transportation of person and property, and at last for the same purpose he traverses the skies.

"Radio now supplements the telegraph and telephone; it has become the voice of ships; it bridges uncharted seas, and spans unsurveyed distances on land. It brings the church, the market, public speech music and instruction into our homes. This most scientific of modern discoveries has become a household factor of common use. The human voice carries with it the elements of personality, force and earnestness, vital to any plea, far more effectively than does the printed word. Broadcasting conveys the expressed thought of one to the minds of many. It is a unique means to that end, and it is unique again in that, in most instances, whatever future development may be, it now has small direct commercial value.

"Measured in dollars and cents of



Long range receiving apparatus installed in the new wireless station of the United States Shipping Board in London. The station picks up messages from Annapolis and Panama with ease. U & U foto.

profit to the transmitter its worth in most cases is small: measured in terms of service its value cannot be calculated. I doubt if there is in the world another activity involving so great an effort in science and invention and such an immense actual expenditure of money in installation and maintenance, not founded on the expectation of immediate financial profit.

"Under existing laws, enacted, by the way, some years before broadcasting had been heard of, our government regulates the transmission of radio messages of all kinds. At first devoted largely to the protection of life at sea, that regulation of late has been particularly directed to broadcasting, and has been made necessary by the crowding of the hitherto free and unoccupied air, which we call interference. By the allocation of wave lengths, the inspection of transmitting instruments and the attempt to induce better methods both mechanical and personal, it is trying to minimize troubles so far as possible in the present state of the art. Avoiding actual control and management, it has left the radio field free to individual research and personal initiative, adopting in this respect a policy unknown to most foreign countries where we frequently find direct management, close control, many restrictions and a strict system of taxes or fees imposed upon all stations and instruments whether for transmitting or receiving. We have chosen rather the minimum of intervention consistent with due regulation, coupled with full assistance in the working out of scientific problems.

"The government has enjoyed invaluable assistance from the persons directly interested, those who transmit and those who receive, and it appreciates the aid given it through the public conferences held under the auspices of the Secretary of Commerce, and the spirit with which all have joined in trying to solve common difficulties.

"Rather than attempt to prophesy tonight, let us welcome this new station, a sturdy youngster, as it needs to be to hold its own with its broadcasting brethren; let us congratulate the men behind it upon the courage, enterprise and genius which have made it possible, and dedicate this latest example of modern magic to the dissemination of knowledge, to the increase of culture, to spiritual development, and to the spread of entertainment and happiness among the countless thousands who will hear its voice."

1126 More Stations

By CARL H. BUTMAN

(Copyright 1923)

Washington, D. C.—The end of the fiscal year shows a gain of 1,126 radio stations of all kinds in the United States, according to the Department of Commerce figures just compiled. On June 30, there were 21,967 ship and land radio stations, whereas a year ago there was a total of 20,841. The increase represents added interest among amateurs and broadcasters who have taken out station licenses during the past twelve months.

$500 for Prize Radio Drama

RADIO broadcasting Station WGY of the General Electric Company of Schnectady, N. Y., is offering a prize of $500 for the best radio drama submitted in competition during the three months' period beginning September 1.

The prize-winning play will be presented by the WGY Players during the winter months when transmission conditions are at their best and when, it can be reasonably stated, a million people will be listening in. An audience of this size will be the equivalent of the attendance at 500 performances of a stage production in a theatre seating 2,000 people. In addition to the $500 prize the successful writer will receive an introduction to a public as large as the reader-circulation of a national magazine and he will have the personal satisfaction of taking a leading part in the development of a new phase of dramatic art. Other plays offered in competition will be produced via the air, if found suitable, and the author will be remunerated in every case.

One year's production of the radio drama by the WGY Players has convinced Martin P. Rice, director of broadcasting for the General Electric Company, that there is a public demand for this type of entertainment and that the peculiar requirements of the radio drama as compared with the stage and the screen production will in time result in a new form of dramatic art. The screen has evolved a distinct type of drama which depends solely on the eye for its appreciation; tomorrow the radio drama will be so written that the listening ear and the imagination, unaided by the eye, will be satisfied. It is for the purpose of stimulating and encouraging the development of the radio drama that the General Electric Company inaugurates this prize competition.

The author of the radio drama must place himself in the position of writing for a blind man. The lines of the characters must convey a picture of the scene in which the action takes place. This apparent limitation or handicap becomes an aid to action, however, as the writer need not restrict his play to three, four or five scenes. For example, he can depict an automobile race and carry his audience through its exciting phases by means of the lines.

He may take his listener from room to room or floor to floor in a dwelling, if farce or melodrama call for such action. The chase, long a popular feature in the early motion pictures, may be brought into the radio play by means of speech. The radio drama requires no scenery. No careful search need be made for locations. The spoken word builds the scenery.

Dramatic situations may be built up by the speaking voice and through the medium of sound-making devices. The writer is encouraged to make use of sound devices and the engineer will provide a means of producing through the air a counterpart of the prescribed sound. Rain, thunder, surf, the roar of a moving train, an airplane, telegraph key or automobile motor may all be reproduced in sound to impart atmosphere and realism.

Those who have written short stories, books of fiction, scenarios or plays, successfully or unsuccessfully, may have the germ of a prize-winning radio drama. Those interested may obtain a folder which sets forth the rules of the competition, with an outline of the special requirements of the radio play, by addressing Prize Composition, WGY Broadcasting Station, General Electric Company, Schenectady, N. Y.

A REAL DRAMA IN WJAZ STUDIO

BRIG. GEN. CHARLES G. ("Hell-and-Maria") Dawes, broke down and wept last night while broadcasting a final tribute to President Warren G. Harding from Station WJAZ at Edgewater Beach Hotel.

The sound of his sobs sped out on the air, borne on the wings of radio, and found their answers in the hearts of thousands of listeners within a radius of a thousand miles.

It all came very suddenly.

Gen. Dawes had been speaking quietly into a microphone, a tiny contrivance of metal, wires and a sensitized disk. He spoke slowly and with emotion. The President had been a very dear friend. He knew that he was speaking to a vast audience, even though only the microphone was before him.

Then came a tenseness, and those who stood by knew that the general was fighting for control.

His voice faltered, broke—and he wept.

The head that was so proudly carried before a senatorial investigating committee when the general, cornered, "cussed" his way out of a tight place and into the hearts of all Americans was bowed.

The general wept, his head in his arms on the table before him, his shoulders shaking with sobs.

"This is station WJAZ signing off," said the announcer. "Gen. Dawes is unable to finish his talk."

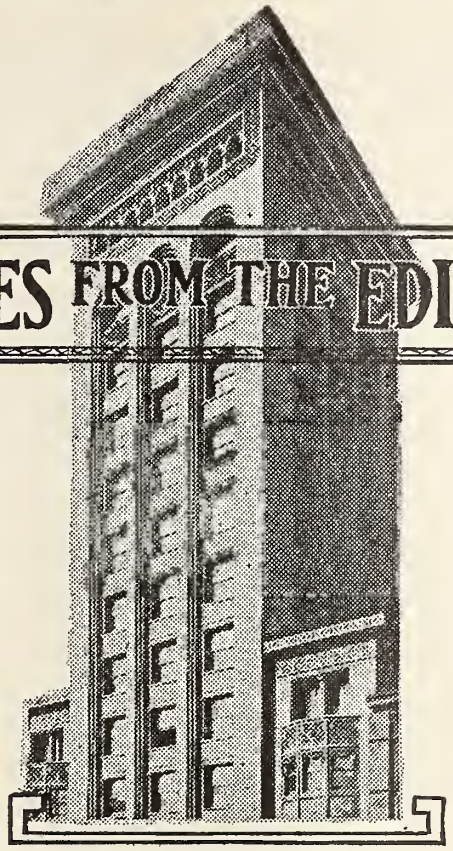
Then came the telephone calls—from all parts of the city from those who had heard that last address, and telegrams from out of town.

So was ended the most dramatic program ever broadcast by any radio station.

—From the Chicago Herald and Examiner of August 4.

Amateur Radio Stations

Districts	Headquarters	June, 1921	June, 1922	June, 1923
1	Boston	2,040	2,489	2,139
2	New York	1,880	2,348	2,055
3	Baltimore	1,325	1,857	2,005
4	Atlanta	208	341	449
5	New Orleans	418	758	948
6	San Francisco	1,136	1,756	1,957
7	Seattle	504	753	864
8	Detroit	1,615	2,354	2,013
9	Chicago	1,683	2,838	3,340
Totals		10,809	15,504	16,57



THOUGHT WAVES FROM THE EDITORIAL TOWER

THE important part played in our daily life by radio was forcibly impressed upon the public when, following the death of President Harding, a majority of the broadcasting stations throughout the country closed down for varying periods as a mark of respect.

The almost complete cessation of broadcasting brought home as could nothing else the important niche which radio has carved for itself in our daily routine in the last two years. People in all walks of life commented upon the gap in their evenings, which they found hard to fill, and while practically all agreed that it was but fitting that the broadcasting of entertainment should temporarily halt while the country sorrowed, probably nothing else connected with the final honoring of our dead President made as deep an impression.

In the death of President Harding, radio lost a good friend. He was one of the first officials of the government to turn radio fan when, following the first radio conference in 1922, the attention of the country was turned toward the new method of entertainment. The set built for his use in the White House was the last word in reception, but while he liked to "play" with it, he had but little time to devote to amusement and found himself for a long time unable to cope with the interference which prevailed when there was but one wave length for broadcasting.

In many ways the President evinced his interest in radio. He gladly accepted the invitation extended to him by the National Press Club of Washington to attend the exercises incident to the "christening" of its receiving set, and while the music and speeches which were to have been broadcast from a nearby government station especially for the occasion failed to "come through," the President stuck around like the good fellow he always was, chatted with the members of the club—which is composed of newspaper men—and gave them a little talk on the difficulties of being President, which gave them much inside dope on the great task which confronts the Nation's Executive from day to day.

While the failure of Congress to pass the White Radio Bill kept radio from becoming an official subject of consideration at the White House, Mr. Harding frequently expressed his interest in the matter and the hope that legislation could be enacted to eliminate interference, give the amateurs the privileges they desired and which he thought they were entitled to, and put radio on a concrete foundation.

President Harding was radio's friend, and the silencing of the broadcasting stations of the country was but a fitting mark of respect to a man who laid down his life for his country as surely as if he had died on the field of battle. No finer tribute could have been paid than the silencing of more than five hundred stations, quiet while the country ceased its activities and a hundred million people mourned.

RADIO once more played an important part in the dissemination of news of a national character, when President Harding died in San Francisco on August 2. The President's death occurred at 7:30 p. m., Pacific time, and the Associated Press had the story out within five or ten minutes, the report being received at the Washington office of that organization at 10:55 p. m., Eastern standard time, or twenty-five minutes after Mr. Harding died.

The news, by air, that the President had died, resulted in a great number of telephone calls to the newspapers and various offices of the Associated Press throughout the country. As a result of the broadcast announcement, the news of the President's death was generally known from thirty minutes to two hours before the newspapers in the larger cities were on the street with an extra.

When wires were down and a storm was raging on election day last November, radio carried the news of important results to the Pacific coast. Radio has taken its place as a disseminator of news.

HE KNEW

A PARTY of city dwellers, returning from an automobile trip into the Adirondacks the evening of July 4 began to discuss the Shelby financial fiasco. It was after 8 o'clock and they were naturally curious about the outcome of the fight. Passing a farm house one of the men in the party saw a radio antenna running from dwelling to barn and he suggested that they ask the farmer for the latest news on the fight.

The farmer was caught as he came in from the barn. He calmly heard their question as though it was the most natural thing in the world that he should be asked the outcome of a fight in Shelby, Montana.

"Dempsey won on points," the farmer laconically answered.

The radio story of the fight, broadcast by WGY, at Schenectady, N. Y. had given the farmer the news as quickly as it arrived in the offices of great metropolitan newspapers.

Radio the World Over

The restrictions against the use of any radio equipment except that licensed by the British Broadcasting Company are making it impossible for English merchants to sell American radio products, according to a report just submitted to Washington by Consul Ross E. Holaday, from Manchester, England.

Consul Holaday, making an investigation of the radio situation, found that the restrictions upon the use of equipment and the regulations governing the use of wireless sets give the British Postmaster General, through his arrangement with the British Broadcasting Company, an ironclad control over radio. There is no prohibition against the importation of foreign radio products, or against their sale after importation, but this freedom is nullified by the difficulty of securing a license to use any equipment other than that endorsed by the "B. B. C." which collects a royalty on every set manufactured in England.

There is now under consideration by the British authorities the issuance of a new form of license to be known as the "constructor's license," under which people with no technical knowledge will be permitted to assemble wireless sets and use them to receive broadcast and other matter. Even those who purchase the sets manufactured under B. B. C. restrictions are required to secure a license before they can make use of their outfits. This is known as a "broadcasting license" and costs approximately $2.50. Only those persons having "experimental licenses" are permitted to assemble their own apparatus, and to secure such a license the applicant must have a knowledge of the technical side of radio which the majority of would-be listeners do not possess.

German Restrictions

Efforts to secure a relaxation of the government restrictions under which private radio installations are prohibited in Germany are being made by a radio club established in Berlin early this year, according to a report from Consul E. Verne Richardson to the Department of Commerce.

It is commented that Germany lags far behind many other countries in private radio enterprise, a great contrast to pre-war times, when Germany was well in front in radio matters.

Aid for Canadian Radio

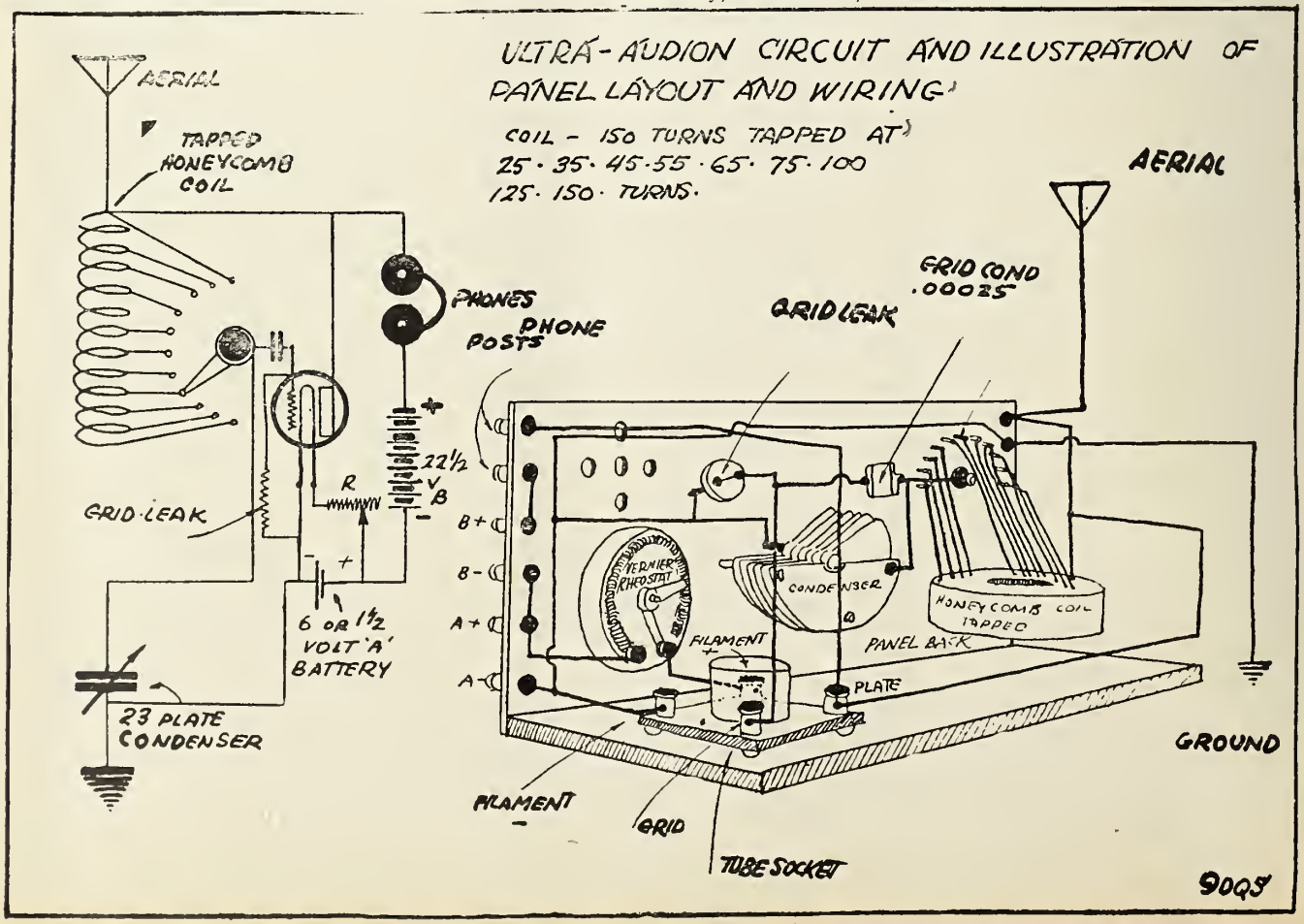
Government aid to the extent of $55,000 has been extended in Canada for the purpose of establishing radio stations at McMurray, at the end of the railroad in Northern Alberta, Fort Simpson, on the MacKenzie River, and Dawson, in the Yukon, according to reports just received at the Department of Commerce. The new stations will displace the land lines at present in use from McMurray, northward, for which the Canadian government has appropriated from $275,000 to $300,000 annually for the last twenty-three years.

Germans Supply Norway

Apparatus for the radio station which is to be built at Bergen, Norway, has been received in that country, according to advices to Washington from Consul George N. Ifft, and preliminary tests have assured the government of its efficiency. Because of the failure of an appropriation for duplex apparatus which would enable the transmission of messages both ways simultaneously, and the failure of the plan to establish a telephone line between Bergen and the Rundemanden radio station, the chief use of the new station will be for the transmission of wireless communications to ships at sea. The apparatus to be used was made in Germany.

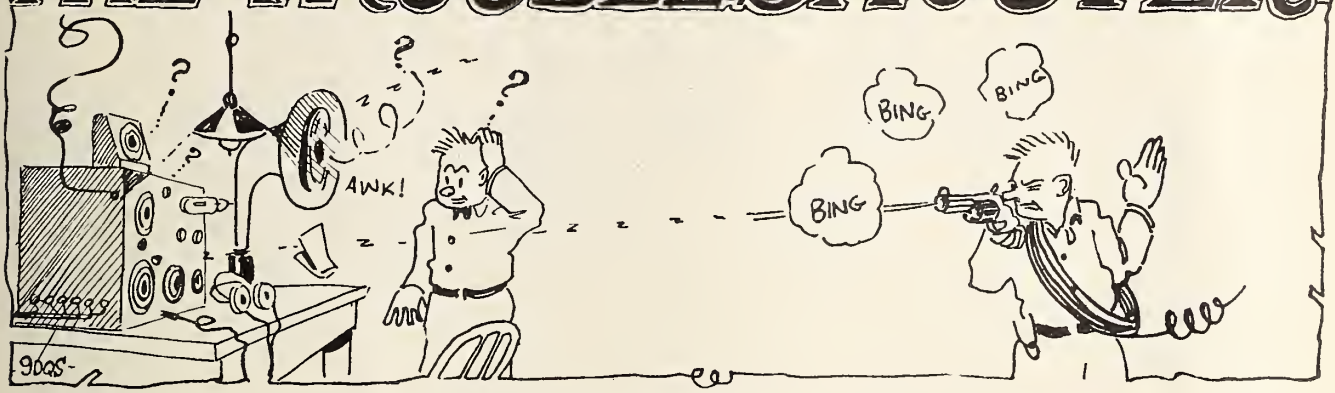
Rio de Janeiro

A radio organization, known as the Radio Sociedade do Rio de Janeiro, has been formed in Rio de Janeiro, and already has more than one hundred members, it is reported by Commercial Attache, W. L. Schurz. Several very influential men of the city are among the officers and directors. It is also announced that a daily broadcasting service will be inaugurated by the Praia Vermelha station.



Try hooking up this circuit using the apparatus you have lying around inactive. Further instructions will be printed in the October issue. It has a substantial range and the ease of tuning which it affords makes it well worth the consideration of the absolute beginner.

THE TROUBLESHOOTER



The technical department sends out many replies to questions in each day's mail. In order to assure prompt service to our subscribers the direct reply method hereafter must be restricted to those fans who are on our subscription list.

Fans who are not subscribers may obtain this service by enclosing 50 cents with their question and the reply will be mailed at once, accompanied by circuit diagram where illustration is needed.

All inquiries should be accompanied by self-addressed and stamped envelope.

W. G. L., Chicago, Ill.

Question: I figure on building a Cockaday four-circuit tuner. Would you advise using No. 18 bell or annunciator wire instead of D C C on the coils? If you have any diagrams of the above circuit in connection with two stages of audio frequency, I would appreciate a copy very much.

Answer: I see no reason why you could not use the wire you mention, excepting that its use will make your coils slightly larger. If you use the annunciator wire do not shellac the coils. I am printing in Figure 1, the four-circuit tuner in connection with a two stage amplifier. The amplifier may be constructed according to the instructions given in the August issue of RADIO AGE on pages five and six.

T. F. W., Chicago, Ill.

Question: I have had greater success with the original Reinartz as described in your book in this circuit, than with any other and I have hooked up quite a few. I am inclosing a drawing I copied and added one stage of audio and I would thank you to advise if you think it will operate well if hooked up as shown. Another stage of audio would of course increase the volume, but I don't care for loud speakers; also advise if an extra inductance is advisable at the point marked X. The variometer I have is or was made by the Diamond Radio Products Company, and consists of two honeycomb wound coils in a square, wooden frame. Please advise if this is OK or name a better one. Do the Crossley people make a book type condenser suitable for the Reinartz? Is a vernier adjustment on these condensers possible? If not, could a three-plate vernier be used instead? My battery is an Edison five-cell auto which I hardly ever have to charge, although I have a Homecharger type R for use with three-cell rating. When I use this charger it starts out charging at a five-ampere rate. The hydrometer always registers 1,200 after charging. Would a voltmeter tell me anything?

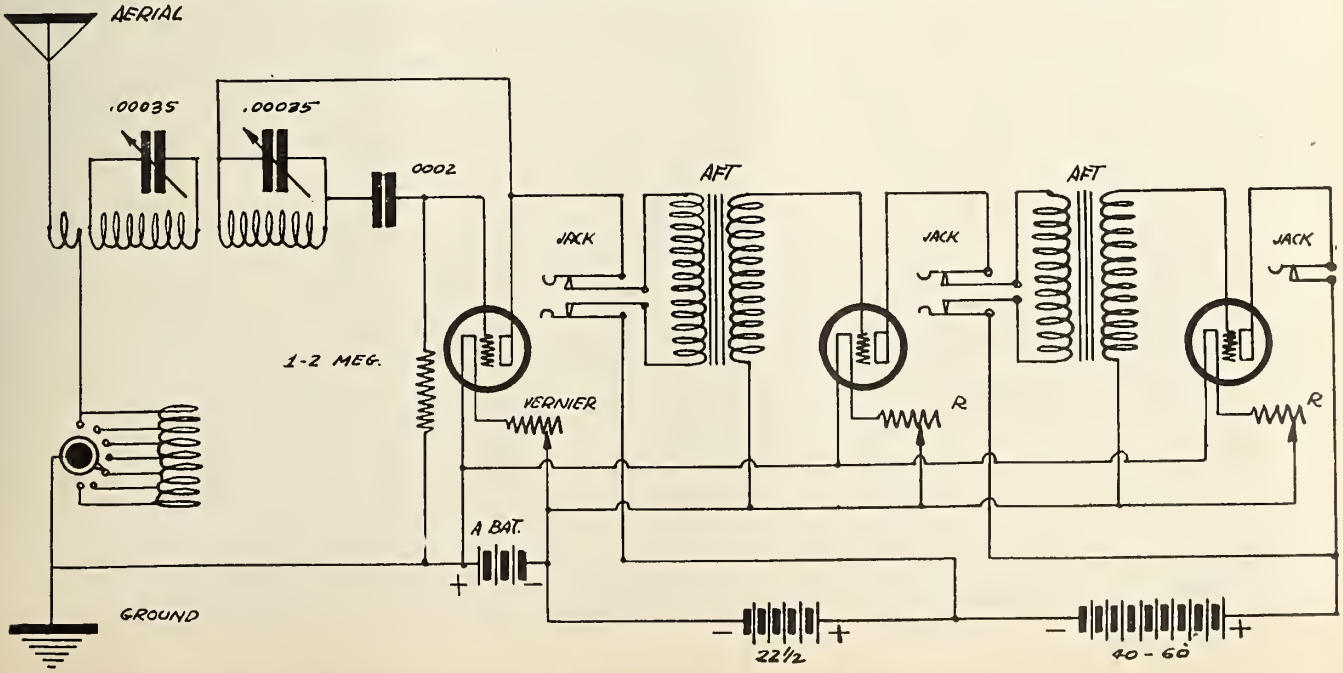


Figure 1. A diagram of the !Cockaday circuit, in connection with a two-stage audio frequency amplifier. AFT are the transformers.

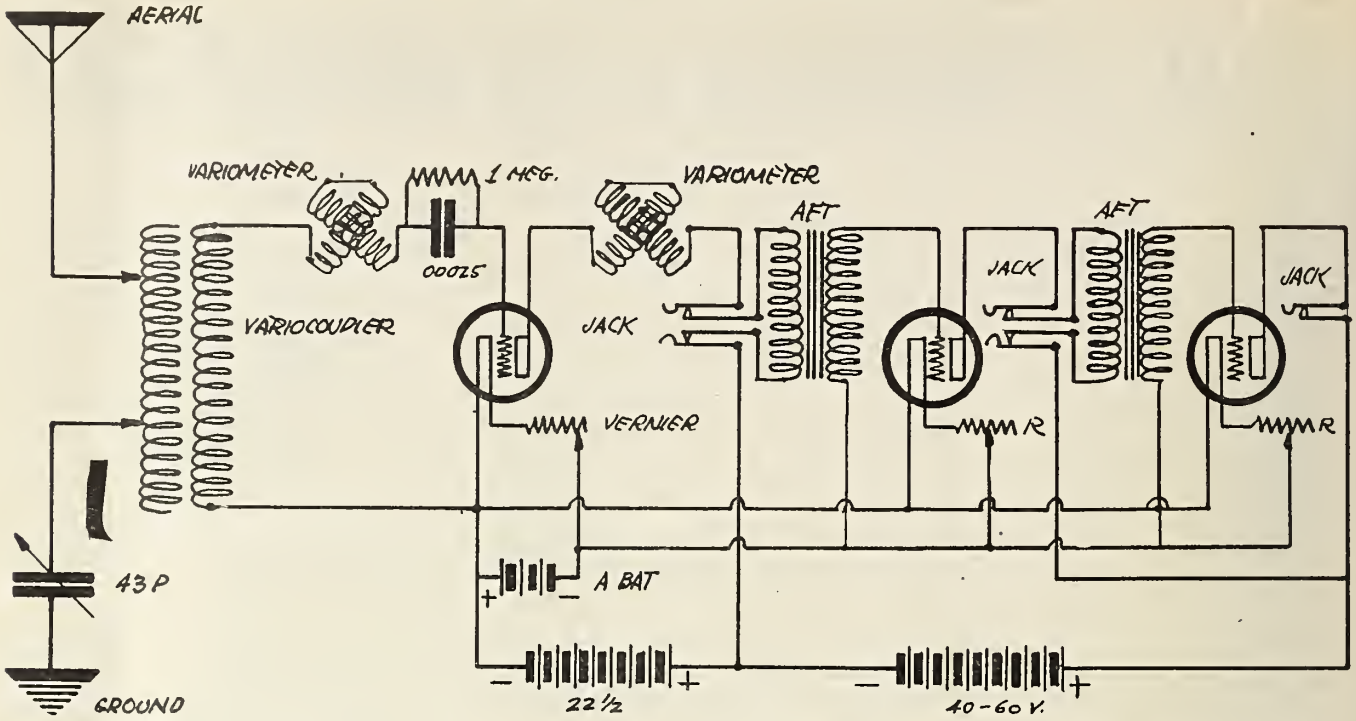


Figure 2. The standard Armstrong three-circuit set, with two stages of audio frequency, is an ideal close tuning broadcast receiver for the use of a BCL who is advanced in the arts of tuning.

Answer: The circuit you submitted is correct. The extra inductance mentioned is unnecessary. I have never seen the variometer which you describe. Probably OK if made by the company named but have never had any experience with it. The book type condenser is supposed to have the same capacity as an ordinary 23-plate variable plate condenser, and owing to its peculiar construction it should be equal to a vernier although I have never had much success using them in a Reinartz circuit. The addition of the three-plate variable would simplify tuning. The battery which you are using is very good. The voltage of these cells is somewhat lower than that of the lead battery which accounts for the use of five cells instead of three, and as the action of your charging apparatus is perfectly normal this should give you no trouble. The addition of a voltmeter would enable you to keep a closer observation of its condition.

H. G. Pittsburgh, Pa.

Question: I own a set but am not getting satisfactory results from it. There are sets advertised by the Experimenter Information Service of New York as Model L and C and I would like to know whether it would be advisable to build one or buy one of the above. I want a set with which I can exclude the amateurs and get distance.

Answer: As I have had no personal experience with the above set, I could not fairly pass judgment on it; however if you wish a good selective set, I would advise that you construct one such as I am printing in Figure 2. This set is giving very good results over long distances, and is about the most selective I know of.

H. S. J. Sioux City, Ia.

Question: In the Erla one-tube reflex set, can you use honeycomb coils instead of the variocoupler and have a twenty-three plate condenser instead of the switches? If this is possible where should the condenser be connected? Can one stage of A F amplification be added in the usual manner? Can a magnovox loud speaker be operated by six volt alternating current? If possible, how is this done?

Answer: The values of the Erla circuit have been carefully worked out, and any change in the construction would bring about doubtful results. This applies to any reflex circuit. Would advise that you adhere to the original plan of using a variocoupler. A one-stage audio

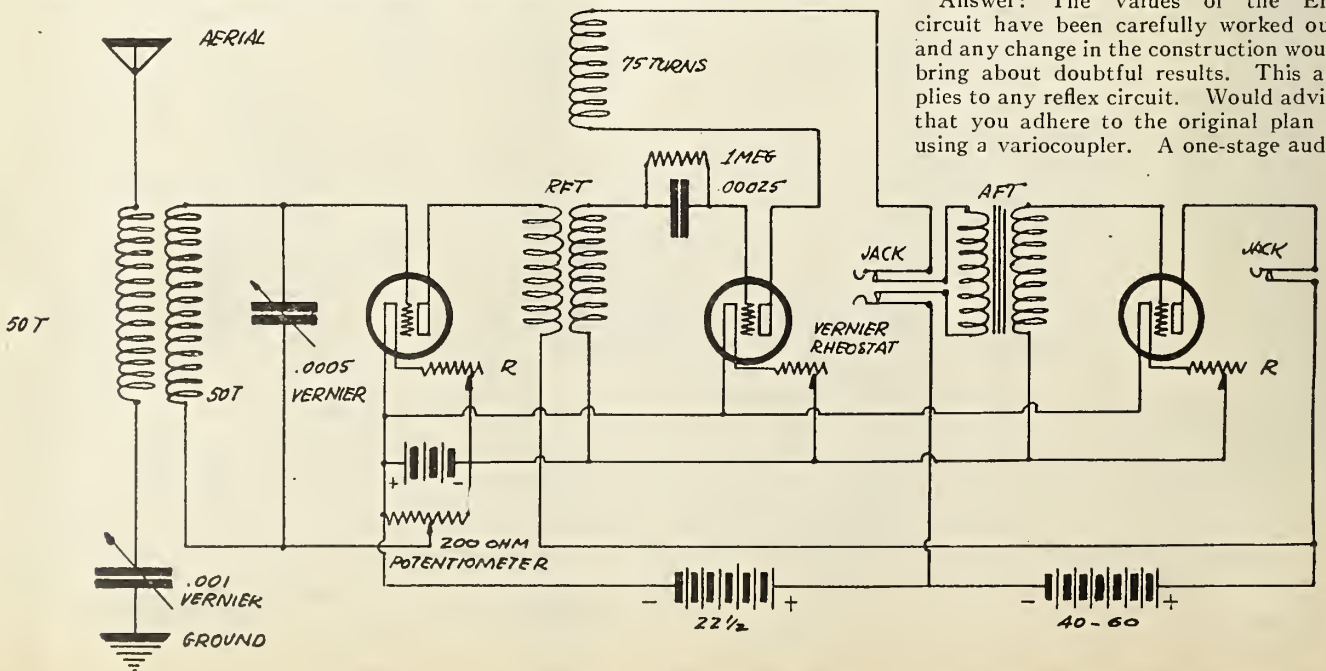


Figure 3. This is the standard honeycomb circuit with the addition of one-stage of radio frequency and one step of audio amplification. RFT is the radio frequency transformer.

frequency amplifier is added by connecting the phone posts of the Erla set to the primary terminals of the audio frequency transformer marked P and B. The tube may be lighted by the same A battery as that of the reflex tube but separate B batteries must be used in the amplifier circuit. The expense involved in properly rectifying the alternating would greatly exceed the cost of a regular six-volt storage battery so I would advise that you do not attempt it.

A. C. McE., Chicago, Ill.

Question: I am a constant subscriber and reader of the RADIO AGE and have benefited by your instructions. Will you please print a circuit showing the method of adding radio frequency to the Standard honeycomb circuit?

Answer: I am printing in Figure 3 a circuit showing how one stage of R F is added to the circuit you inclosed.

O. B. G., Paris, Ill.

Question: I understand that a six-volt battery charger can be made using aluminum and lead plates with an electrolyte as a rectifier. If this is possible will you please send me the instructions?

Answer: I am sending under separate cover the issue of RADIO AGE which contained the constructional data on the making of the charger you have in mind. This charger was designed for homes having a 110 volts alternating current source of electricity.

A. E. H., Munfordsville, Ky.

Question: I have completed a circuit that I got from RADIO AGE and corrected the wiring of the secondary that by oversight was not connected to anything. I am enclosing a diagram of a circuit that I am trying to use, but I am not getting satisfactory results. Anything that I will have to change please write me.

Answer: I have looked over your hookup, and although I can find no apparent faults will say that the trouble is probably caused by either the honeycomb coil being placed in the wrong position so that the windings oppose each other or that your coil is not large enough. A condenser as indicated should help. Your inductance coil should be placed directly over the secondary coil of the variocoupler. Make sure that your antenna system is not at fault, and that no poor connections exist.

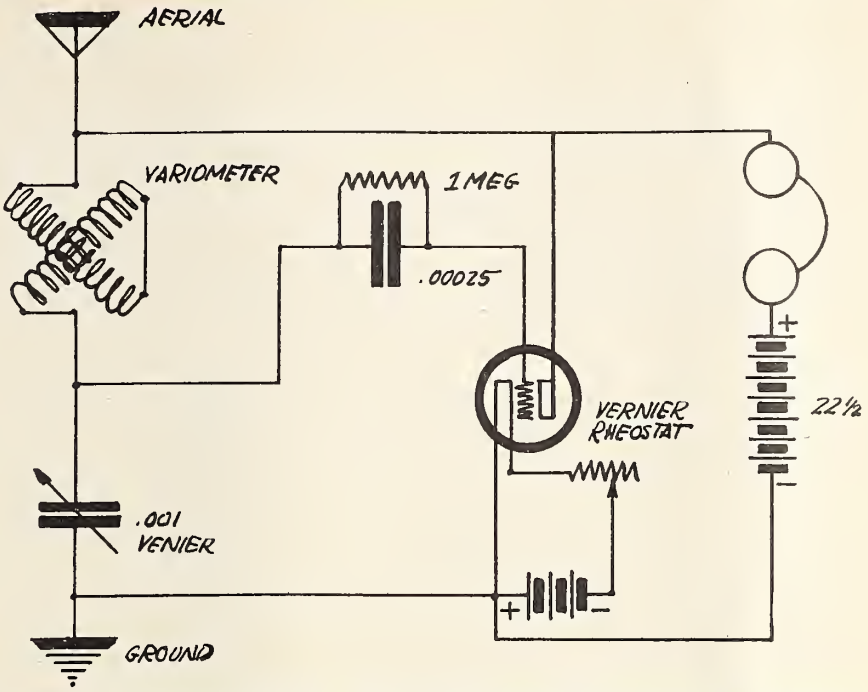


Figure 4. The W D 11 circuit. This circuit is especially adaptable to the beginner who does not wish to construct or operate a set which would require painstaking construction and difficult tuning. Many of our readers are having remarkable results with this circuit.

D. W. I., Youngstown, O.

Question: I am a reader of the RADIO AGE and think it is a good magazine for hookups. I have an antenna sixty-five feet high at one end and thirty-five at the other. Which end would be the proper one to take the lead in from? Please print a circuit of a set using a variocoupler, a variable condenser, grid leak and condenser B battery, etc., in connection with two stages of audio frequency. What should be the dimensions of a loop antenna to be used with the above circuit? What ohmage of phones would be the best for this circuit?

Answer: The lead end would be taken from the end nearest the set you are going to use. If you will refer to the August issue of RADIO AGE, on page sixteen, you will find the diagram you are looking for. A loop satisfactory for this circuit can be made by winding about ten turns of No. 24 D C C wire on a frame three feet square. A headset of good sturdy construction, having a resistance of from 2,000 to 3,000 ohms is satisfactory for this set.

P. R., Omaha, Nebr.

Question: Please inform me if any dealer in my city stocks .00005 fixed condensers as specified in the Kaufmann circuit. If not, please state firm and price at which I may obtain them.

Answer: The condenser which you mention is very hard to obtain as it is not a standard size. The best arrangement is to procure two ordinary grid condensers of .00025 Mf capacity and connect them all in series. This will give the proper value for the Kaufmann circuit. Do not make a mistake and

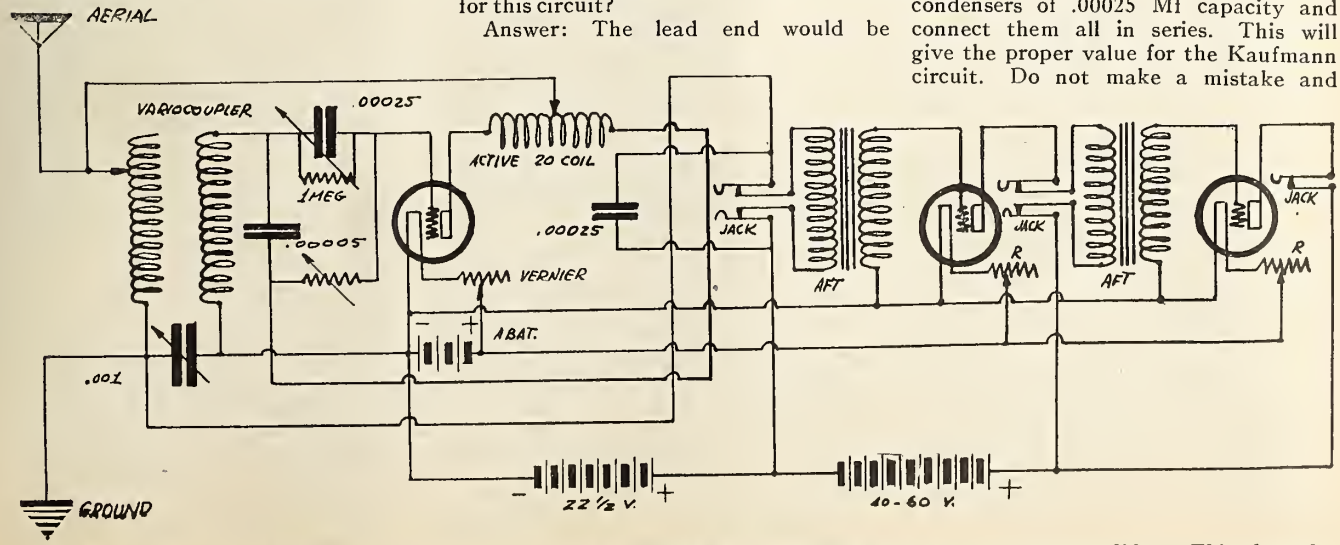


Figure 5. Many of our readers have been asking for a circuit of the Kaufmann set with a two-step amplifier. This shows how the connections are made.

connect them in parallel or the circuit will not work.

R. G. W., Kansas City, Kans.

Question: Please print a hookup of a simple long distance tube set. I am a beginner, and something of efficient and simple nature would be appreciated.

Answer: I am printing in Figure 4, a circuit which is especially adaptable to your purpose. Many of our readers are using this circuit with remarkable results. The simplicity of its construction and operation will doubtless be of interest to many of our beginners.

H. M. C., Coal City, Ill.

Question: I have just finished the Kaufmann circuit, and would like very much to add two stages of audio frequency amplification. Would a standard amplifier circuit function with this circuit? If you have any information relative to this on hand would be pleased to receive a copy. I have assembled two of the Reinartz circuits and have heard nearly every station in the United States and Canada. I am especially anxious, therefore, that the Kaufmann circuit I have constructed be a success.

Answer: I am printing in Figure 5, the Kaufmann circuit in connection with a two-stage amplifier. This amplifier may be constructed according to instructions given in the August number of RADIO AGE. The queer arrangement of the components in the Kaufmann circuit requires the use of a separate plate battery for the amplifier as shown.

H. D. M., Omaha, Nebr.

Question: I would like to know if you can give me the size of tube for coil and size of wire used in winding the inductance in Mr. Smith's adaption of the Bureau of Standards crystal set of which he had a pencil drawing in your July issue.

Answer: The size of the tube used in the Bureau of Standards crystal set is three and one-half or four inches in diameter, and long enough to accommodate the required number of turns. I would not advise the use of a tube of less than three and one-half inches in diameter, as this would reduce the inductive effect of the coil.

E. A. N., Hopwell Junction, N. Y.

Question: I would like to know if the coil C (bank wound) in the four-circuit tuner of the August issue is anchored where it starts and also where it ends. How is it held down to the mounting board? Is the coil tube holding A and B fastened down to the board by blocks of wood with common screws? Can the binding posts for the antenna, ground and amplifier be mounted on the back of the set instead of the front as shown?

Answer: Figure 6 shows how the bank wound coil used in this circuit is constructed. A hole is punched in the tubing and the wire is drawn through. The winding is started in the usual manner for a single layer coil, until the second turn is completed. The third turn, instead of being placed next to the second, is wound on top of the first two as shown. The bank-wound coil is held in place by the rigid copper bus bar wire used to make connection to the taps. If the connections here are soldered firmly, no other support will be necessary. The coil, holding A and B is raised on two small bakelite strips to allow the single turn of copper bus bar wire to pass around the coil. The binding posts for antenna, ground and amplifier may be placed as you suggest. If an amplifier is to be added immediately, it is not necessary to use these two posts. Connect the two central springs directly to the first A F transformer, the top center going to the post marked B and the lower center spring going to the post marked P.

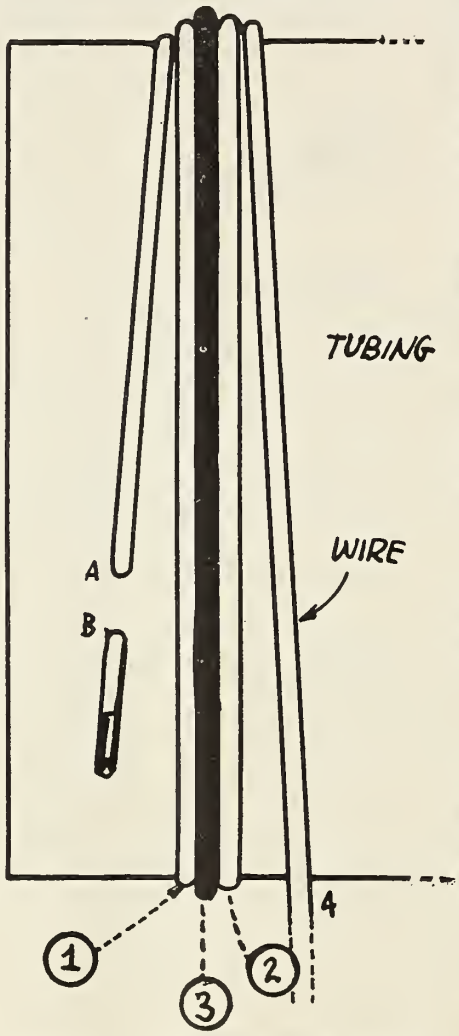


Figure 6. This illustrates the construction of the bank-wound coil, used in the Four-Circuit tuner. Two holes are punched at A and B and the first turn is put on as shown at 1. The second is wound immediately alongside of 1, and the third shown at 3 is wound on top of these two in the groove formed by the wires 1 and 2. The fourth turn is wound alongside the second, and fifth is wound in the groove made by 2 and 4.

Japanese radio enthusiasts are firmly convinced that in the very near future the present laws against aerial communication in Japan will be lifted, the Western Electric visitor announced. Although the government has refused to license any broadcasting or receiving stations to date, Japanese dealers in close touch with the situation are reflecting their optimism in the future by stocking up with radio receiving sets to be sold once the ban is removed.

Oh, Boy!

When a small boy is confronted by the problem of choosing between a radio concert and studying for examinations, the radio generally wins, that is if mother and father are not near to influence the choice.

A ten-year-old Philadelphia youngster writing WGY at "Skednety," N. Y.—Schenectady was a little bit too much for him—took advantage of his mother's absence and scribbled a note to WGY as follows:

"I was one of your many radio fans of Tuesday night, June 18, 1923. I wish you to accept a thousand compelments from me. I am only a boy ten years old and a radio fan. I have built a set with a peanut tube. My mother says I pay more attenchion to it than to my studies and this leter looks it. I was lisning Tuesday night to WFI in my own city and all of a suddan I heard in a stearn loud voice 'this is station WGY, the next number is —? It blotted out WFI intirly. You had some power. Oh, boy."

Verry cincerly Yours.

(Name withheld for reasons shown in postcript).

"P. S. My mother is out I guess it looks it. Please excuse this as I haf to get it out to you before she sees it. She will tare it up and say 'Get to your studies young man,' as my examanations are going on."

Evidently mother came in before the young Philadelphian could get a stamp for his letter. In the upper right hand corner, generally decorated by a postage stamp, he had written "Colect on the other end please."

Radio Plot!

A postal card received by Forecaster Charles L. Mitchell, of the Chicago Weather Bureau, August 8, two days before the violent wind and rain storms, stated that a gang of men were manufacturing bad weather by means of wireless. The writer again on August 13, after the storms, informed Mr. Mitchell that the gang were plotting to continue to terrorize the people through the same method. The first postal card follows:

"August 8—Weather Man:

"I tell you there are a gang of men who work and make wireless weather, through electricity and these fellows are doing this for spite. They make lightning and thunder, and wind storms and thay are southwest in Clearing or Argo, and are heard plane in Auburn Park plotting weather and other plots. You can here them through radia."

The postal was unsigned.

The second card was as follows:

"Mr. Mitchell:

"I wrote you this week about these men out here. Thay say thay are going to keep the heat up and lightning and thunder. Thay use these means to terrorize the people thay tell over the radia that they will strike and kill with lightning and electricity. They have told me again they are going to make electricity storms and heat waves and thay have the heat rays on all the house besides."

Little Things That Help

.00005 MF Capacity for Kaufmann Circuit

Inasmuch as this circuit calls for a condenser of so small a capacity, the reader constructing this set will find it hard to secure a condenser of this capacity, as they are not standard, and very few dealers stock them. A simple way to substitute for this is to purchase two condensers of .00025 MF capacity and connect them in *series*, as shown in Figure 1. This will give the proper capacity necessary for this circuit.

Another way to do this is to take two pieces of thin copper five-eighths of an inch square and separate them with a mica dielectric, such as used in heating-stove doors. This is, of course, not absolutely accurate as the thickness of the mica will have much to do with the capacity, but others have used it successfully. This is a special size and for this reason very few supply stores can supply a condenser of this capacity. The best and most accurate arrangement is the two condensers in series.

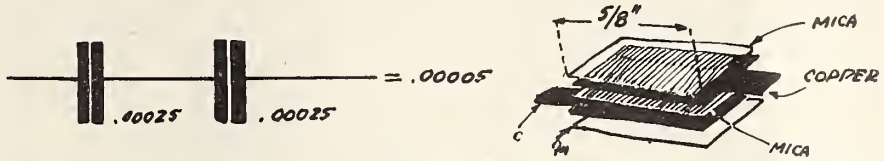


Figure 1. By this arrangement, the correct capacity for the .00005 MF condenser used in the Kaufmann circuit can be obtained.

Unmounted Audio Frequency Transformers

Due to the fact that unmounted audio frequency transformers are not shielded, it is a good plan to ground the cores of these transformers, as a precaution against stray inductance which might cause trouble in producing distortion, noises and other limitations in an amplifier.

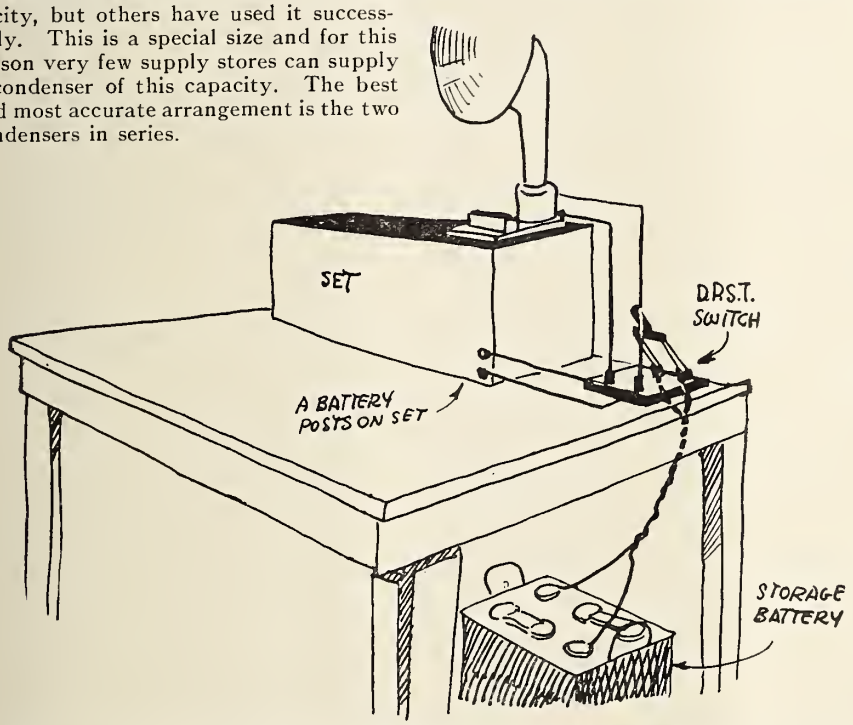


Figure 3. This illustrates the use of a double pole, single throw switch used to protect the storage battery from unintentional discharge.

Don't Unwittingly Discharge Your Storage Battery

Many BCL's are probably unaware of the fact that if they allow their power loud speakers to be connected to the filament battery, they are unknowingly discharging their storage batteries. These power speakers draw a heavy current, and to leave them connected while the set is not in use is an unnecessary waste of valuable current.

This also applies to the potentiometers on sets, where they are connected directly across the filament battery as a grid bias or plate battery control. If the potentiometer you are using does not include an off position, it will dissipate a small amount of current. The best way to avoid this is to disconnect one of the A battery leads or provide a double pole, single throw switch in the leads, as shown in Figure 3.

If this method is used, there is no danger of letting your tubes burn all night or the power speaker or potentiometer to dissipate current.

FOR 30 DAYS

Don't miss the great subscription offer described on the back cover of this issue. The rate positively will be withdrawn on October 1, 1923. Write now.

A Good Ground Connection

A good ground connection is very essential in the course of long distance reception. Many of our readers are probably using water pipes for this purpose and do not want to create an unsightly lump of solder on the pipe and at the same time are experiencing trouble, due to the fact that the wire or ground clamp will not stay in place on the scraped surface of the pipe.

About the most simple method to assure that a connection is established at all times is to use an arrangement shown in Figure 2. A piece of common lead or tin foil is wrapped firmly around the pipe, and around this the wire or ground clamp is placed. The connection should be as firm as possible, and if wire is used it should be wrapped firmly around the tinfoil. The tinfoil being very easily crumpled will make positive contact where the wire could not reach and also affords greater surface against the scraped piping.

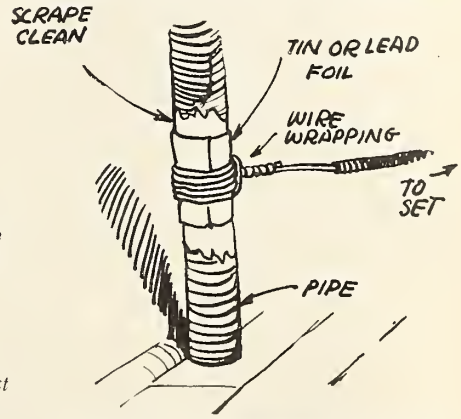


Figure 2. This arrangement shows how to make an efficient ground connection, when water pipes are used.

Mrs. Coolidge a Fan

Mrs. Calvin Coolidge, new "First Lady of the Land," is an ardent radio fan, and derives much pleasure from her set, which is a large one of improved type. Mrs. Coolidge for some time has had a set installed in her room at the New Willard Hotel, used temporarily as a "White House" following the death of Mr. Harding and the elevation of Calvin Coolidge to the presidency, and will probably take it with her when Mr. Coolidge takes official possessoin of the White House.

Pick-up Records by Our Readers

George W. Jeffers, of Pennsgrove, N. J., an ardent BCL and experimenter, writes us to the effect that he has made some tests with the Kaufmann circuit, the results of which he describes as follows:

"I constructed a Reinartz set according to your specifications and blue prints, with no changes, and have to this date since the change of wave lengths received forty-three stations, the farthest being over one thousand miles, using a detector and two stages of audio frequency. When using head phones attached to the horn, I can bring in New York, Massachusetts, Chicago and Philadelphia stations with ease and great volume. I constructed a Kaufmann circuit of your design, and had a little trouble in making it operate satisfactorily. After experimenting a little, I struck upon the idea of adding an aerial condenser of 23 plates and then, *you should have heard it coming in the horn on twenty-two volts. Boy, you are there*! I am,

Very truly yours,
GEORGE W. JEFFERS.

Mr. Jeffers' find will probably interest other readers, and we are printing in Figure 1, the Kaufmann circuit in connection with the addition from which he gets such good results.

The method by which he found this out is interesting as shown by his second letter to the technical department:

"I am enclosing herewith a pencil sketch of my addition to the Kaufmann circuit. I hope it will be of service to others if they find the same conditions as I have.

"With the antenna and ground direct to the instrument, I could not get the proper results, but I found that by disconnecting the ground wire and holding it between my thumb and finger very loosely it would bring in the signals clear and loud. Tightening the fingers resulted in decreased signal strength. This adjustment brought to mind the fact that probably my fingers were acting as a condenser, and I immediately placed one as shown. With the condenser in the aerial it will work fine and dandy. Everything in the set is according to your specifications, excepting that I have added a phone jack. I have no trouble in getting WDAP, of Chicago. I am using a single wire antenna about seventy-five feet long, thirty feet high with a thirty foot lead-in.

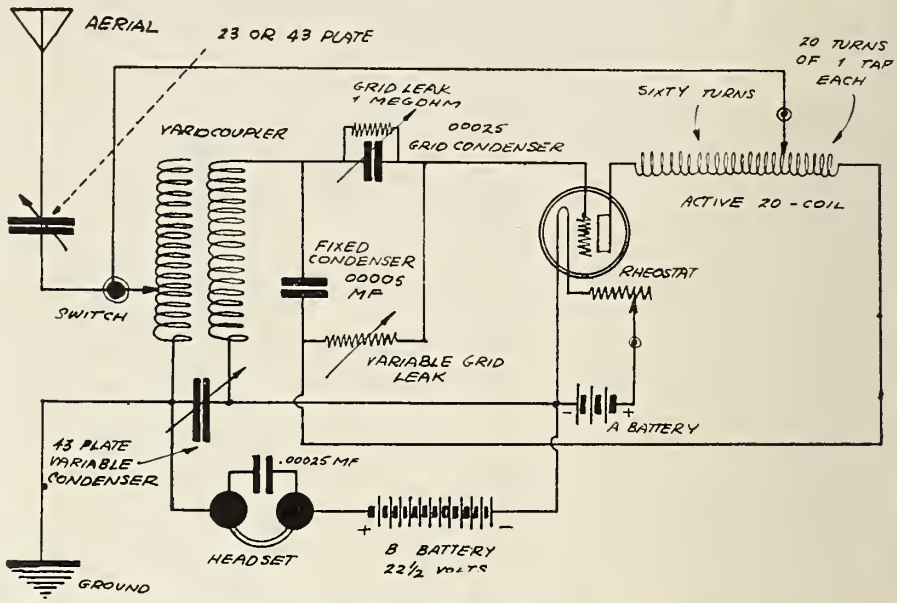


Figure 1. The Kaufmann circuit, showing where Mr. Jeffers placed the condenser in the antenna lead. This improves the circuit greatly, he claims.

R. G. Wittle of Chicago reports that with a set, constructed according to the instructions given in RADIO AGE, using the Kopprasch circuit, he has, during the summer months since May, received the following stations: Minneapolis, Minn.; Jefferson City, Mo.; Memphis, Tenn.; New York City; Troy, N. Y.; Davenport, Iowa; Kansas City, Mo., and all local stations.

Mr. Wittle contends that the secret of this set is in the connections of the variometers, which must be correct to get results. He is awaiting the radio frequency addition to this circuit, in order that he may increase his range.

J. H. Jones, of Crestwood, Ky., writes:

"I am using a Reinartz circuit, constructed according to your specifications and a two-stage AF amplifier in connection with an art mache loud speaker, and the signals have been heard over a radius of two blocks. He evidently knows how to hook a set up.

W. G. Lehr, of Chicago, Ill., who recently featured the Reinartz circuit with many long distance stations to his credit, wants to know if we want the dope on his circuit. We certainly do, Mr. Lehr, let us hear from you soon.

He further writes:

"In my opinion RADIO AGE is far ahead of any radio magazine published when it comes to real radio information. The only fault I can find with it is that you do not publish it often enough. A month seems too long to wait for it."

Many of our readers are writing in and asking for the correct connections on the terminals on the transformers in the Erla circuit of the May issue.

N. A. Bleischer, of 3126 Cambridge Avenue, Chicago, Ill., informs us that he is getting the best results when the transformers are connected, as shown in Figure 2. He says that he uses the phonograph in his home in connection with the phone unit of his head set, and hears local stations all over the house. He has only had the set for a short while, and claims no spectacular reception, but we sincerely hope that as the cold weather sets in he may be able to do the same with the DX stations this fall.

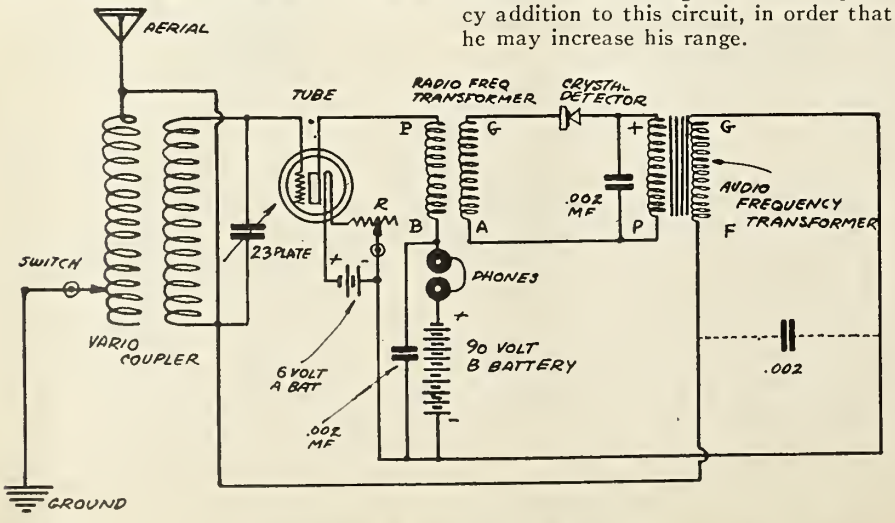


Figure 2. With this arrangement of the transformers, one of our readers, who is using the Erla hookup, says he is getting remarkable results. The .002 fixed condenser across the secondary of the audio transformer is material in bringing this about, he contends. This condenser is indicated by the dotted lines.

FOR 30 DAYS

Don't miss the great subscription offer described on the back cover of this issue. The rate positively will be withdrawn on October 1, 1923. Write now.

Is World Flat?

Radio Age, Inc.,
Boyce Building,
500 N. Dearborn St.,
Chicago, Ill.
Gentlemen:

I note in your July issue, page 32, an article entitled "Now it is Zion," and wish to make some corrections on same.

Station WCBD is located at Zion, Ill. (not Zion City), and was installed at a cost of $40,000 (not $30,000), broadcasting on 345 meters (not 245 meters), and have no angel choir, but a choir of good, faithful men and women singers.

Overseer, Wilbur Glenn Voliva, believes the world flat, being far ahead of Christ, Columbus and modern astronomy, being a graduated astronomer himself. His ideas and ideals as to the shape of this world are backed by the Bible, surveyors and navigators. He also offers a big reward for any proof that the world is the shape of a sphere, so, why ridicule him?

I would like to see this station listed in your list of broadcasting stations, and enclose a schedule of same.

Yours respectfully,
RAYMOND C. BAURLE
Chicago, Ill.

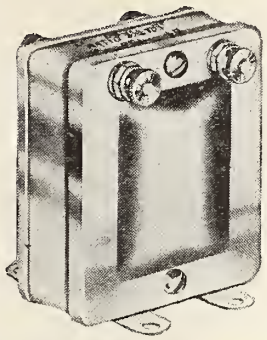
Future of Radio Compass

Position-finding by wireless is destined to be one of the most important navigational aids of the future, whether employed alone or in conjunction with sound to obtain synchronous signals, according to D. W. Hood, M. Inst., C. E., engineer in chief to the Corporation of Trinity House, London, who was among those present at the International Congress of Navigation, held in London last month. George R. Putnam, Commissioner of Lighthouses, was among the American delegates to the convention, which was declared to be the most important meeting of the kind ever held.

In his report, Mr. Hood referred to the fact that various countries have different direction-finding systems of their own, and recommended that an investigation be made to find the most effective method, not by individual countries but by one agency under an international agreement.

The establishment of radio fog signals was the most important advance in lighthouse work in the United States during the last ten years, according to a paper read at the conference by Commissioner Putnam. The first of these signals were placed in service on May 1, 1921, when three were put into commission in the vicinity of New York Harbor. The number of such stations has been increased during the last year and others are in course of preparation.

Each of the radio fog stations in United States waters sends automatically during fog or low visibility radio signals on a wave length of 1,000 meters, with a distinctive characteristic, which are used by vessels equipped with radio compasses. Very reliable results are being obtained, Mr. Putnam declared.



TESTED AND APPROVED BY RADIO AGE INSTITUTE

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with National Audio Frequency Transformers

There are many reasons why National Transformers are demanded and used by the majority of experts and amateurs—greater volume—absolutely no distortion—no interaction between fields—perfect results on any stage of amplification and with any type of tube—scientifically perfect—sturdy construction—beautiful design—highly nickel finished.

National Transformers are equally efficient on the Cockaday, Reinartz, Neutrodyne, Reflex, Flewelling, Inverse Duplex and other recently developed circuits. Can be used with all types of tubes on the market. Remember Mr. F. D. Pearne has tested the National and given it his personal endorsement.

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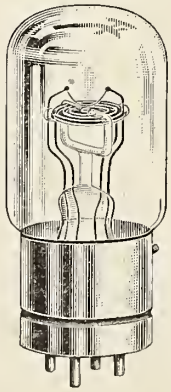
154 WHITING STREET Dept. 916 CHICAGO, ILLINOIS

Genuine Telefunken Tubes

Amplification without distortion. May be used as amplifier and detector.



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Test made by F. D. Pearne, of Radio Age:
6-Volt filament potential.
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Please send me.....Telefunken tubes as per advertisement. I agree to pay postman $5.95 on delivery. You guarantee this tube to operate as represented or will exchange for new tubes.

Name.....

Address.....

City.....State.....

A Fragment of MacMillan's 1923 Trip to the Arctic

(*Continued from page 10.*)

too close to get a picture. To bring them out of their hiding places, it was only necessary for us to lie on the ground for about five minutes. Then the heads began to bob up all around. We took some species of these birds and also some species of the eggs. These are as large as hens' eggs and are one source of food to the natives. Captain MacMillan has been supplied with permits from the Canadian, New Foundland, and Danish governments allowing him to take whatever specimens he desires.

While the Captain, Fairbanks. and I were on this Island, three of the crew decided to visit their first iceberg. Directly after they left it, the iceberg decided to turn over. It was very fortunate that this did not occur while they were on it, for they would have been lost. It was interesting to hear the captain tell these men, upon their return, the lurking dangers of the iceberg. At the same time he figured out for them the enormous tonnage in this particular iceberg. It looked so small. Only one-tenth of it showed above water.

Paraquet Island is located in the Canadian Labrador section. On the mainland, one-half mile away, a tent was perched in open view. This, we were later informed, belonged to the government game warden, but the Canadian government, although equipping him most excellently in every other way, failed to furnish him with a boat.

As we passed north along the Coast of Labrador, it was seldom that the fog permitted us to see land. The curtain very accommodatingly raised as we passed Point Amour, where we were given an opportunity to take pictures of the wreck of the battleship, Raleigh, once the pride of the British navy, but now piled up high and dry on the rocks. Even her guns are still mounted. While passing through some of the thickest of the thick fog, the rocky shore of Labrador only a short distance from us on our port side, but yet completely shut off from view, the cook, who was on his first trip to the Arctic, came on deck and the captain, pointing towards where he knew the land was, said, "Well, Cooky, how do you like your view of Labrador?"

The cook gazed intently and seeing nothing but fog, sighed, "Is it always like this?"

The Captain answered, "No, not always." But Robinson at that point confided the surprising information that the captain had seen the whole Coast of Labrador without fog only once in his fifteen years of Arctic exploration.

The coast, when visible, is an enormous pile of unfriendly rocks. I shall take occasion to quote verbatim from Captain Cartwright's "Journal of Labrador," written in 1780. In describing Labrador on page 341 of his book, written 143 years ago, Captain Cartwright said: "Although in sailing along this coast, the astonished mariner is insensibly drawn into a conclusion that this country was the last which God made and that he had no other view than to throw together there the refuse of his materials of no use to mankind (I shall interrupt Captain Cartwright to say that the Coast of Labrador has not changed, since he so adroitly described it in 1780. I shall continue with Captain Cartwright). Yet the mariner no sooner penetrates a few miles into a bay than the great change, both of the climate and prospects, alter his opinion. The air then becomes soft and warm; bare rocks no longer appear; the land is thick-clothed with timber, which reaches down almost to highwater mark, and is generally edged with grass. Few stout trees are to be met with, until you have advanced a considerable distance and have shut out the sea." This description of Captain Cartwright's may be true of some sections of Labrador, but we failed to find that section in our trip. What we saw was dismally cold, barren, rocky, and uninviting.

The natives of the villages who make their living by fishing the cod and the salmon have in their back yards piles of wood, sometimes fifteen to twenty feet in height, the largest piece not exceeding two inches in diameter. It is all of scrub growth. The missionaries told us that in the winter the poor inhabitants must travel miles and miles with their dog sleds, quite content to find even this scrub growth. It is true that the air becomes warmer as you travel inland, but it is also true that the moment it does become warmer you see flies as you have never seen before. The air was literally thick with flies. A picture taken by Dr. MacMillan on a previous expedition shows the back of Labrador Cabot's shirt a seething mass of flies and the shirt visible at no spot.

Snow everywhere on the mountain tops and enormous balls of ice on the shore. At one point we had eighty-nine icebergs visible from our crow's nest. One of these icebergs was in the form of an arch, so high that had we been sure the water was clear below we could have sailed our ship through. The very names of the bays, capes, and islands indicate the hardship that has been experienced on this God-forsaken country. Here are some that are strongly descriptive:

Devils Bay, Mistaken Cove, Blow Me Down, Cut Throat Tickle, Icey Cove, Lower Savage Islands, Hopewell Narrows, God Haven, Misery Bay, Cape Fair Well, Cape Hold With Hope, Death River Frozen Strait, Escape Reef, Refuge Cove, Cold Foot River, Deadman's Cove, Savage Cove, Isle of God and Mercy, Battle Harbor, Fairness, Windy Tickle, Ragged Island, Cape Comfort, Punch Bowl, Lost Hope, Dead Man Lake, Repulsed Bay, Bay of Mercy, Anxiety Point, False River and Fly Away Cape.

As we entered each of these Labrador ports a group of small dories would invariably put out from the shore, and a race start among the fishermen to see which could reach us first. After the usual preliminaries of getting acquainted, would follow the question, "Is there a doctor on board?" Next, they asked clothing of any description. We found many of the hardy fishermen, bronzed, weather-worn, and thin, clothed in a pair of old looking castoff oilskin trousers, a threadbare sweater, a battered pair of boots, and nothing more. The fishing had been bad for the last two years. There is an abundance of fish this year, but the inhabitants are faring poorly because of the enormous quantities of ice which tear their nets into pieces and ofttimes carry them away completely. These people are mostly of French, Irish and Scotch descent.

In one port a native offered us lobsters for sale. He had a dozen and apologetically explained that the price of lobster was very high this year. Having left the states but recently the argument of short supply and over-demand was not new to us, and we were quite prepared for a South Water Street price. So he asked the exorbitant figure of ten cents a piece for the lobsters. Wherever we went, people were all agog with excitement over the radio carried on board. They were glad of visitors; glad of the chance to exchange courtesies, but glad especially to view, as many as could, the equipment of the Bowdoin. Their wonderment struck its height when they heard the receiving set, heard voices and music from far away places in the United States, the land they know but little and none had seen. It was gratifying to notice their frank and open reaction, so childlike. so sincere. No electric lights in the homes of these, no telephones, little of the conveniences that we Americans enjoy.

On his last trip, Dr. MacMillan showed the natives moving pictures. Strange to say they do not consider the radio a mechanical or electrical device. When they saw the moving pictures they believed it was Dr. MacMillan's ability to make the spirits move on the screen. As for radio, they believe that in the year Dr. MacMillan has been back, he has learned how to make the spirits talk.

On July 4 the icebergs completely surrounding us, we received the returns of the Dempsey fight, and the pool which was started on board for him who guessed the number of rounds the fight would last was won by Jaynes, the engineer, and paid to him when the twelfth round was reached, that being the number he selected. But the money was promptly taken away from him when the fight went fifteen rounds.

In Battle Harbor where I left the expedition we were met at the dock by the doctors and nurses of one of those wonderful institutions, the Grenfell Mission, where seif-sacrificing men and women give of their time and energy without remuneration, caring for the sick and injured that are brought to them from miles around. Contact with them was especially delightful. They made an indelible impression for their devotion to a noble cause, their unselfishness, their genuineness and ease of manner, and their lively interest in us as visitors. They visibly enjoyed everything just as the natives, but had the added advantage of education and refinement. They, too, were completely absorbed with the radio, although they were not by any means ignorant as the

natives of radio. They not only enjoyed listening to the radio concerts but took every opportunity to dance to the strains of faraway stations, even the Edgewater Beach hotel station in Chicago.

Being an old yachtsman, I may have taken too many things for granted in omitting much which to me is commonplace, but perhaps interesting to others. In describing the trip sketchily, I tried to be brief without neglecting the more important phases.

One thing remains to be said, however, and that has to do with Dr. MacMillan, himself. What I enjoyed as much if not more than anything of all the trip, was the opportunity to study and know in close quarters that wonderful optimist —Dr. Donald B. MacMillan. It might not savor of good taste to speak of him as a friend, as a man, as a captain, because it would probably offend his sensitive nature to have me praise him thus openly, but I may without danger of indelicacy to him refer to his optimism, which to me is unparalleled. If it rains, it rains. If it is cold, it is cold. If there is a mishap of any kind it is accepted by Dr. MacMillan in contented spirit, and in full confidence that no matter what occurs, it is for the best. He never looks backward, always forward. He sees a bright side to every situation, every occurrence. He is a real optimist.

Dr. MacMillan and his crew were well and happy when I took my leave. One comforting thought over the separation was realizing that communication would not be cut off with them, as before, until their return to civilization, but would be kept intact by means of the first thing of its kind to be introduced to the land of the Eskimo—the land of solitude, that which really is responsible for my introduction to Dr. MacMillan, that which made possible my trip with him as far north as Labrador, that which will help us get MacMillan's interpretation of what he sees and hears on his expedition to the North Pole—radio.

Radio Goes Exploring

By Carl H. Butman

Equipped with a special radio receiving set, a party of ten explorers from the Geological Survey left Lee's Ferry in northern Arizona on August 1, for a three hundred mile trip down the Colorado to the mouth of the Virgin River, at Rioville, Nev.

Unfortunately these modern surveyors, who are following the route first explored by Major Powell fifty-four years ago, were unable to carry a radio transmitting set due to weight and space. But they are carrying a modern receiving set and will be able to hear what is going on in the world during the three months, although they will be unable to return daily their adventures in mapping this stretch of the Colorado. Arrangements have been made however with the radio stations of the Deseret News of Salt Lake City and the Los Angeles Times to broadcast bulletins sent from trail crossings. The dispatches will be relayed by runners and telephone or telegraph when the party gets far enough down the Colorado to reach the regular lines of communication. In this manner the world will be advised of the progress of the exploration in the Canyon and passage of the four boats through some of the wildest rapids in the country.

The special radio set was reconstructed by Mr. R. L. Atkinson of the Survey, from a standard Westinghouse regenerative set, adapted to two stages of amplification with new tubes. The whole outfit, including the batteries, is packed in a water-proof, wooden box with sponge rubber to keep it from jarring during the long boat trip. An especially constructed antenna on a reel, capable of being erected at camp sites on the banks of the river, can be strung from short poles or from projecting rocks to a length of 150 feet.

A preliminary radio set at Lee's Ferry has already been made, and it is reported that the explorers received broadcasts from Los Angeles, 430 miles away without difficulty at night. The real reception test Col. C. H. Birdseye, who is in charge of the party, believes will come when they are in the lowest part of the Canyon, estimated as a mile deep, near El Tovar, where dead spots and static may be encountered.

Besides the geological and topographical results achieved, the trip will also prove of material interest in the development of radio communication, along with experiments undertaken by the Bureau of Mines, and other governmental bureaus, to see how far radio will carry into the "bowels of the earth."

Frequency Indicator

At the Second National Radio Conference held in Washington, it was resolved:

"That every broadcasting station should be equipped with apparatus such as a tuned circuit coupled to the antenna and containing an indicating instrument or the equivalent for the purpose of maintaining the operating wave frequency within two kilocycles of the assigned wave frequency."

The Bureau of Standards has designed a preliminary model of a radio frequency indicator to meet the above need and has prepared specifications covering its construction. These specifications may be had by any broadcasting station upon request.

The instrument consists essentially of a 72-turn space-wound coil on a 3¾" tube, an air condenser, and a sensitive thermo-galvanometer. These three elements are connected in series. The condenser, which is of the variable type, is provided with a locking device so that it may be locked and soldered into position after the instrument has been adjusted to indicate the required frequency. This instrument may be set to indicate any radio frequency in the range from 1,350 kilocycles (222 meters) to 550 kilocycles (545 meters).

If any instrument is constructed according to the specifications and sent to the Bureau of Standards, Radio Laboratory, by a licensed broadcasting station, it will be adjusted for a nominal fee to operate at the frequency of the station.

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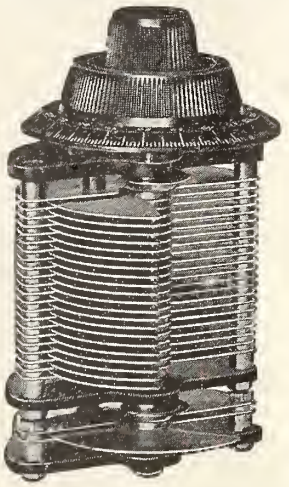
improve the range, clearness and tone quality of both nearby and distant broadcasting. Voluntary testimony from appreciative users all over the world leaves no doubt about this. The reasons are in the instruments themselves—their electrical correctness, and their precision workmanship, from better-than-need-be materials.



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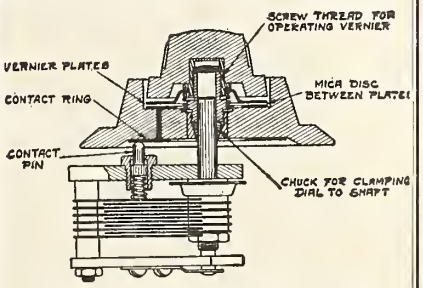

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"Hootch" Tubes Defraud Radio Public

THE BOOTLEGGING of vacuum tubes used in radio receiving sets has grown to be one of the most widely-practiced and highly profitable by-products of prohibition. Its importance is second only to the business of rum smuggling itself. With a potential market of nearly a million dollars worth of tubes per month, the radio bootlegger is playing a big game. His net profit is generally as large, if not larger, than that of the whiskey runner and his danger of apprehension and punishment seems much less.

Beginning about a year ago on a small scale with the manufacturer of various crude types of tubes which were easily spotted, the radio bootlegger has developed his business to the point of so skillfully and accurately counterfeiting the products of several prominent manufacturers that only an expert is able to detect the difference. In the course of examining the receiving sets of about forty amateurs a day for the past year and a half, the Sunday Call has been afforded an unusual opportunity of examining a large variety of vacuum tubes, and whereas it was formerly a very simple matter to detect a bootleg product because of its faulty construction, the job has now become one requiring the closest examination.

The manufacture of the so-called "standard" vacuum tubes is in the hands of a closely knit group, comprising the General Electric Company and the Westinghouse Electric and Manufacturing Company, from whose factories come the U. V. 200, U. V. 201, U. V. 201-A, U. V. 199, W. D. 11, W. D. 12 and, in addition, a series of tubes used largely in transmitting circuits. These tubes are sold through the Radio Corporation of America to the jobbers and dealers of the country. From the General Electric factories also come a series of tubes identically the same as listed above, but bearing the trade designation C. 300, C. 301, C. 301-A., C. 299, C. 11 and C. 12 and the signature of E. T. Cunningham. These tubes are widely used on the Pacific coast and have recently been introduced into New Jersey through the State distributor, E. M. Wilson and Son, 11 Lafayette Street, this city.

Copies of "Peanut" Tubes

Another important manufacturer of standard tubes is the Western Electric Company, makers of the V. T. 1 and V. T. 2, used extensively by the Signal Corps of the United States Army, the 216-A used as a power amplifier and the "N" (peanut) tube employed as a detector, as well as a radio and audio amplifier. The latter tube, although not sold for amateur and experimental use in this country has attracted considerable attention here. The interest thus aroused has been capitalized by the bootleggers, who have placed copies of this tube on the market.

Steal Fruits of Research

The development of "standard" vacuum tubes to their present high point of efficiency has been achieved only after the expenditure of hundreds of thousands of dollars by the companies mentioned above. The patents resulting from this costly experimentation represent a form of protection for the manufacturer against the pirates of industry who seek to profit by the fruits of another's labor and brains.

Patents mean nothing to the radio bootlegger, however. Not only does he steal the fundamental principle which has taken a legitimate firm years to develop, but he completes the job to the last detail by counterfeiting the tube in size, shape and even in the design of the trademark.

Newark is reported to be the biggest source of bootleg vacuum tubes in the country, but strangely enough, fewer bootleg tubes are sold in this city than in any radio center of its size and importance in the United States. The local public is afforded a large measure of protection through the integrity of the dealers and through the medium of the personal service feature of the Sunday Call's Radio Department, which is available for testing tubes and apparatus every day except Monday from 2 to 5 p. m. A constant watch over the radio market is maintained by the Call's staff for the protection and information of its readers. Because of this fact radio bootleggers find it more profitable to seek other dumping grounds for their products.

Seven Newark Bootleggers

From a source believed to be very reliable the Sunday Call learns that there are approximately seven "factories" engaged in the manufacture of bootleg tubes in this city. The combined capacity of these plants is figured at 3,500 tubes a day. There are five additional factories in New York and Brooklyn, this latter group being capable of producing about 2,000 tubes a day.

The reason Newark is such a big manufacturing center for bootleg tubes is because this city and vicinity affords the greatest market for skilled labor and materials, vital necessities to the bootlegger. In Harrison, just across the Passaic River from Newark, is the General Electric plant, employing thousands of workers—mostly girls—on the various processes of vacuum tube construction. In Bloomfield, another suburban town, is the Westinghouse Lamp works, also employing thousands of trained workers on radio tubes. In these factories inexperienced labor is taken and thoroughly trained in the delicate work of tube making. Once thoroughly trained and experienced, this labor is recruited by agents of the bootlegger who are known to have approached workers leaving the factories. Higher wages is the usual bait, but bonuses are offered to the girls skilled in the more delicate branches of the work.

With this labor at his command the bootlegger is better able to carry out the details of counterfeiting standard tubes. There has come to the attention of the Sunday Call some excellent copies of the U. V. 199. It is difficult to tell the copy from the original. Its weakness is in its extremely short filament life, the average bootleg lasting only a few hours as against 1,000 hours, the normal service of a standard tube. The bootleg 199's examined have a higher rate of current consumption than the genuine and a low percentage of electron emission, which means poorer service. This is largely because the bootlegger is unable to obtain the proper filament material and is obliged to substitute a flattened platinum wire, which, incidentally, is also obtainable locally.

Earmarks of Fakes

The counterfeit U. V. 199 is distinguished by the fact that the R. C. A. G. E. and W. trademarks impressed in white on the glass may be erased by rubbing a moistened finger over them. On the genuine these trademarks are etched on the glass and cannot be removed. The printing on the base of the tube is frequently badly smudged on the bootleg, whereas on the genuine it is quite clear and readable.

In addition to counterfeit U. V. 199, the Sunday Call has discovered fake Western Electric "N" tubes U. V. 200 and U. V. 201, De Forest D. V. 6, W. D. 12 and U. V. 201-A. Another article to be published shortly, showing how counterfeit tubes may be distinguished from the genuine, will be given.

Boon to Light-Keepers

Radiophone communication between light stations in isolated territory has been found very successful by the Lighthouse Service, according to reports to the Department of Commerce. Complete stations were installed at Cape Sarichef and Scotch Cap Light stations, Alaska, in 1921, and after overcoming some difficulties of operation during the first year, due to burnouts of the motor generator and wrecking of one of the steel antenna masts by a storm, communication between the stations has continued uninterruptedly for the past year.

The two stations are about seventeen miles apart. Keepers at both stations have mastered the code, so as to be able to exchange messages with mail steamers, and have been able to communicate for a distance of sixty-five miles by voice and 165 miles in code. The telephone installation at these stations consists of a type C. W. 936 short-range radio telephone set, two three-fourths K. W. 32-volt Delco engine-driven generators, two seventy foot steel poles and the antenna and ground system.

How Radio Visualized Harding Funeral

THIS is a story of the first attempt of a broadcasting station to visualize by means of music and spoken word a current event of large significance—in this case the final tribute paid President Harding in the city of Washington.

The listeners of WJAZ—the Zenith-Edgewater Beach Hotel Broadcasting Station were carried in imagination to the starting point of the funeral cortege and accompanied the sorrowful procession step by step up Pennsylvania Avenue, now to the tune of "Abide With Me," again to children's voices singing "Nearer My God to Thee," again to the inspiring strains of "Onward Christian Soldiers," the impressive "Chopin's Funeral March," Harding's favorite "Lead Kindly Light," and so on up the wide stairs of the Capitol Building. Then as strong male voices sang "Lead Kingly Light," the coffin mantled in the Red, White, and Blue was placed on the catafalque in the rotunda. The brief and impressive funeral services followed which were concluded by the sounding of taps.

When the procession got under way the bells of St. John's Episcopal Church began to toll "Nearer My God to Thee," and continued until Reverend J. Freeman Anderson's voice was lifted in prayer. "Nearer My God to Thee" played by the church chimes fell on the ears of the mourners loud and clear at first, fainter and fainter as the procession neared the Capitol, the key-note as it were of the pathetic spectacle.

All this passed before the mental vision of the listeners with the aid of the word pictures painted by N. A. Fegen. The introductory words of the program spoken by E. F. McDonald, Jr., the narrative of N. A. Fegen, and the text of the invocation follow.

WJAZ was the recipient of enthusiastic comments on the effectiveness of this program. To some people it was so realistic as to bring tears.

INTRODUCTION

By E. F. McDonald, Jr.

This evening's newspapers give the account of the Washington ovation to the earthly remains of President Harding. The Zenith-Edgewater B e a c h Hotel Broadcasting Station will repeat the strains of music which echoed the feelings of the throng of sorrowers and fondly enveloped the body of him who had won to an extraordinary degree the love, esteem, and respect of his fellowmen. Most of the musical selections were the favorites of the man about whom and for whom the solemn demonstration.

Recital of the episode will be made by Mr. N. A. Fegen and the music will be played and sung by the Oriole Orchestra and the Crystal Studio Quartet.

Directly after this Presidential program taps will be sounded and there will be a pause of ten minutes. Then the Zenith-Edgewater B e a c h Hotel Broadcasting Station will go on the air with classical music from the Crystal Studio.

So that our listeners will be able to tune in satisfactorily, we shall start the program by playing one of Mr. Harding's favorites, "Abide With Me."

By N. A. Fegen.

The evening's program of the Zenith-Edgewater Beach Hotel Broadcasting Station having been curtailed out of respect for the dead President, the occasion will be taken to play and sing the music that filled the air of Washington today while countless souls felt poignant sympathy as they viewed the remains of President Harding borne along. The body of President Harding was today carried from the White House to lie in state in the Capitol Building of silent Washington draped in black. Let us visualize that solemn journey, the last of the President on Pennsylvania Avenue, so different from the festive pageant of his inaugural a little over two years ago; let us view that journey with our mind's eye by repeating music which gripped the heart of the hushed multitude. The funeral services were simple, but to those who attended will ever be memorable for their impressiveness. There were short prayers, a brief Scripture reading, the singing of a few hymns, hymns favored by the dead President, and then was ended the official tribute of the United States to Warren G. Harding At 10:00 a. m. the funeral procession started from the White House. The escort was made up of President Coolidge, the Cabinet and Diplomatic Corps, leaders of Congress, two former Presidents —Wm. Howard Taft and Woodrow Wilson—civic organizations and many prominent citizens. Hardly had the first of the procession started under way when the bells of St. John's Episcopal Church across LaFayette Square—the Church of Presidents—began tolling.

Bells by Smith.

As the funeral cortege passed the District Building, 3,000 wide-eyed school children, their little hearts oppressed by the national calamity, tenderly and with deep devotion for him so suddenly taken away from his people, strewed flowers in the path of the procession and sang "Nearer, My God to Thee."

Quartet.

Pennsylvania Avenue, rich with the memories of historic scenes, presented two long aisles of grief. As the great procession of sorrow swung out and beyond the District Building, the Marine Band with its crepe muffled drum played "Onward Christian Soldiers." Listen to the majestic strains and know why those who stood in Pennsylvania Avenue felt a catch at their throat and their hearts jump a few beats.

Orchestra.

The procession continuing, strains of "Chopin's Funeral March" were wafted up and down Pennsylvania Avenue.

Orchestra.

Arrived at the Capitol, the Army Band, as the coffin was carried up the steps, played "Lead, Kindly Light." Immediately preceding the services the Male Quartette of the Calvary Baptist Church sang "Lead, Kindly Light."

Quartet.

Then followed the Invocation of the Rev. J. Freeman Anderson, Pastor of Calvary Baptist Church. It expresses a beautiful sentiment, and being brief, will be repeated for the edification of the Zenith-Edgewater B e a c h Hotel Broadcasting Station and audience.

Invocation Read by N. A. Fegen.

The funeral services came to a close after a short reading of Scripture. It just so happened that the verse read from Micah, the eighth from the sixth chapter, is the one upon which President Harding's hand rested when he took the oath of office, the same Bible which George Washington kissed at his inaugural services.

In the rotunda of the Capitol rested the remains of President Harding. The people of Washington had their last look at their beloved President.

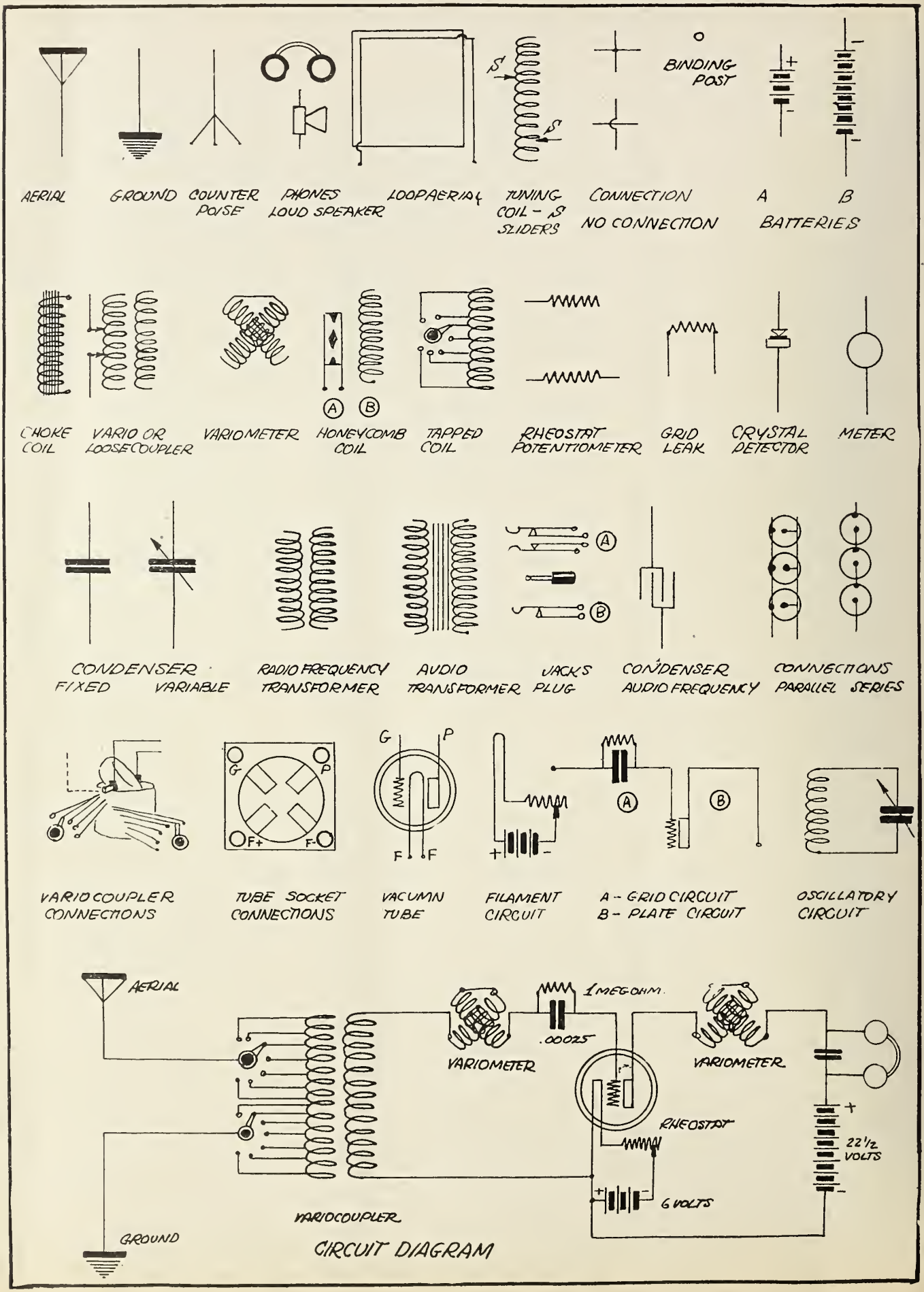
(TAPS.)

Dr. Anderson's Invocation Delivered at 11:40 a. m., August 8, 1923.

"Our gracious God, close to whose great Father heart alone our weary hearts find rest, breathe, we beseech Thee, Thy sorely needed benediction of peace upon the mourning millions today, and especially upon those who shared most intimately the good life of our lamented leader. Behold, we are submerged under a great sorrow! With a startling suddenness, distress of uncommon depth and darkness has broken upon us and our stricken Nation echoes the psalmist cry, 'Thy waves and Thy billows are gone over me.'

"Out of the midst of the storm is there come to us, each and all, the voice of our Divine Helper, Who walks in triumph upon the waves, saying, 'Peace, be still, when Thou passest through the waters, I will be with thee, and through the rivers, they shall not overflow thee.' Beyond all the depressing shadows that conceal our sky, this hour gives us, with uplifted eye of faith, to see clearly Him Who is the Light of the world, Whose radiance is cloudless and fadeless, despite our earth born tempest—God, Who standeth amid the shadows, keeping watch above His own; beyond all unfulfilled dreams and broken plans and bitter disappointments, to know that all things work together for good to them that love God.

"Give us befitting resignation amid the mystery of Thy wise providence that, like little children bending slowly and humbly at the feet of a father whose mind is far beyond their comprehension, we may say with a new submissiveness, 'Thy will be done.' Driven by the blow of this great grief to merge our hearts in common sympathy and prayer, teach us to hold ourselves on the high level of fraternal spirit and of consecration to humanity's largest good. And 'Lord God of Hosts, be with us yet, lest we forget, lest we forget.' We ask all needed grace in the Name that is above every name and at which every knee shall bow. Amen."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1 MEGOHM.
.00025
VARIOMETER
VARIOMETER
RHEOSTAT
22½ VOLTS
6 VOLTS
VARIOCOUPLER
GROUND
CIRCUIT DIAGRAM

BROADCASTER LOSES

Judge Lynch, sitting in the United States Court, Trenton, N. J., granted an injunction on August 11, restraining L. Bamberger & Company, operators of a large department store in Newark, from broadcasting music copyrighted by a member of the American Society of Composers, Authors and Publishers.

The court nullified his own order for the time being, however, by stating that he would not sign the restraining order until it had been passed on by the higher courts. It was the opinion of the court that L. Bamberger & Company was making an indirect profit from its radio station.

The suit was brought by attorneys for M. Witmark & Son, and has been regarded as the first important legal action promising a definite and final adjustment of the question as to whether broadcasters can be forced to pay royalties for the use of copyrighted music in their broadcasting stations. The particular song, which it was complained the department store had broadcast illegally was "Mother Machree." Chauncey Olcott and Ernest K. Ball wrote the music for the song but they are not parties to the suit. Rita Johnson Young wrote the lyric, but she is not a party to the suit. The action is brought solely by the publishers.

Witmark asked for a temporary injunction. The defense of the department store station was that it was not operating for profit. The music publishers had demanded $1,000 a year from the station in payment for the use of copyrighted music. The store refused to pay and the suit resulted. The radio world will await the action of the higher courts with some interest.

Radio for the Blind

Letters which come to the radio broadcasting station emphasize the enjoyment which the stay-at-homes get from broadcast music. One such letter is that received recently by the General Electric Company station at Schenectady, N. Y., from a young blind woman who lives in Seneca Falls, N. Y. Writing to WGY she says:

"If you could know how much we enjoy the voice of the Schenectady station, you would be glad that God gave you such a gift. My father, who is very hard of hearing, can hear you distinctly and knows your voice already although we are only two weeks old in the radio world. Father could get nearly all the service and sang the hymns with the choir.

"My work is so very exhausting that even when there is an invitation to get some recreation, physical weariness makes it impossible to enjoy anything. The constant association with sick people, the worry of expense and the strain of trying to do things without sight, the care of a father who has been feeble a long time, and the anxiety of a mother, seventy-four years old, who has had to work so hard to serve a deaf husband and blind daughter, all these things brought me to a dreadful state of mind, distrusting everybody and sorry for myself. No honors conferred on a celebrity could have given greater pleasure than the church service gave two people, one deaf and the other blind and hungry for something good and helpful. The talk which I heard about Christ and Christianity was a greater banquet than any that was ever spread before the greatest man.

"I do wish that some philanthropist who would like to do something for the blind would furnish radio sets to those who are less fortunate than I."

Movies by Wireless

Washington, D. C.—The near future will see the perfection of radio movies; essentially, they are here today. Every "listener-in," with the aid of a special apparatus, contained in a box about a foot square, and a small curtain, will be able to see as well as hear over the versatile radio, according to C. Francis Jenkins of this city.

Professor Jenkins, who has previously demonstrated the transmission of still pictures by radio, recently showed on a screen in his laboratory the movements of his hand and other objects held in front of his radio transmitting apparatus in another room. The apparatus used in transmitting still pictures was employed in the last experiment, but a new "lens-faced prismatic ring" was introduced to show a rapid succession of pictures depicting movement.

Perfection of the moving picture radio transmitting set now awaits only the manufacture of a new and more powerful electric lamp of the "corona-glow" type. In the recent demonstration a temporary lamp was made by the inventor but it is not strong enough to transmit large pictures. The question of rapidity is solved, Mr. Jenkins says, as he has already sent pictures at twice the standard movie speed. What he needs is a better and stronger lamp which will stand up when the signal strength is increased about 3,000 times, as is necessary in sending pictures in motion.

Not only actual pictures of moving bodies can be transmitted, by pointing the machine at them, but films can be broadcast, Mr. Jenkins claims and shown on screens in theatres or homes where proper receiving and reproducing apparatus and a screen are available. When the power of the light is raised the size of the picture can be increased, it was explained.

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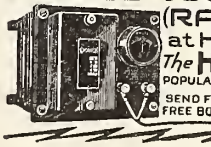

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Complete Each Issue

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IXAD, Pawtucket, R. 1, 1000 miles; Special license experimental; Standard Radio & Electric Co.
KDKA, E. Pittsburg, Pa.; Class B station Westinghouse Elec. & Mfg Co.
KDOW, Steamship America, New York.
KDPM, Cleveland, Ohio· Westinghouse Elec. & Mfg. Co.
KDPT, San Diego, Calif.; 244 meters; 50 watts; Southern Electrical Co.
KDYL, Salt Lake City, Utah; news music, entertainment, Telegram Publishing Co.
KDYM, San Diego, Cal.; Savoy Theatre; 252 meters 100 watts
KDYQ, Portland, Ore.; Oregon Inst. Technology.
KDYS, Great Falls, Mont.; Class B, Great Falls Tribune.
KDYW, Phoenix, Arizona; Smith Hughes & Co.
KDYX, Honolulu, T. H; 12:15 to 1:15 p. m., stock reports and weather; 6:30 to 7:30 p. m., music, lectures; Sunday, 11 a. m. to 12:30 p. m., sermons; Honolulu Star-Bulletin, Ltd.
KDZB, Bakersfield, Calif.; Frank E. Seiffert.
KDZE, Seattle, Wash.; 455 meters; 500 watts; The Rhodes Co.
KDZF, Los Angeles, Calif.; Automobile Club of Southern California.
KDZI, Wenatchee, Wash.; Electric Supply Co.
KDZK, Reno, Nev. Wednesday 8 to 9 p m; Friday 8 to 9 p m. Musical and news features; Nevada State Journal, Nevada Machinery & Electric Co.
KDZQ, Denver, Colo. Pyle & Nichols, 1247 Broadway.
KDZR, Bellingham, Wash; 261 meters, 50 watts; Bellingham Pub. Co.
KFAD, Phoenix Ariz.; Class B, McArthur Bros. Mercantile Co.
KFAE, Pullman, Wash.; State College of Washington.
KFAF, Denver, Colorado; George S. Walker, Western Radio Corporation; musical programe, news items, etc., daily except Tuesday and Sunday, 8 to 9 p m; mountain standard time.
KFAJ, Boulder, Colo.; University of Colorado.
KFAN, Moscow, Idaho; Electric Shop.
KFAP, Butte, Mont.; Standard Pub. Co.
KFAQ, San Jose, Calif.; City of San Jose.
XFAR, Studio Lighting Service Co., Hollywood, California 280 meters, 200 watts.
KFAU, Boise, Idaho; Class B, Boise High School.
KFAV, Venice, Calif.; Abbott Kinney Co.
KFAW, Santa Ana, Cal.; 280 meters; 10 watts; Radio Den.
KFAY, Central Point, Ore.; W. J. Virgin Milling Co.
KFBB, Havre, Mont.; F. A. Buttrey & Co.
KFBC, Phoenix, Ariz.; Nielson Radio Supply Co.; 238 meters; 10 watts.
KFBE, San Louis Obispo, Calif.; R. H. Horn.
KFBG, Tacoma, Wash.; First Presbyterian Church.
KFBK, Sacramento, Calif.; 283 meters; 100 watts; Kimball Upson Co.
KFBL, Everett, Wash.; Leese Bros.
KFBU, Thomas, Bishop, N. S., Laramie, Wyo.; 283 meters. 50 watts.
KFCB, San Diego, Calif.; 278 meters; 20 watts; W. K. Azbill.
KFCD, Salem, Ore.; F. S. Bartin.
KFCF, Walla Walla, Wash.; Frank A. Moore.
KFCH, Billings, Mont.; Elec. Service Station.
KFCK, Colorado Springs, Colo.; 242 meters; 10 watts; Colo. Springs Radio Co.
KFCL, Los Angeles, Calif.; Los Angeles Union Stock Yards.
KFCM, Richmond, Calif., Richmond Radio Shop.
KFCQ, Casper, Wyo.; Motor Service Station.
KFCP, Ogden, Utah, Ralph W. Flygare.
KFCV, Houston, Tex., Fred Mahaffey, Jr.
KFCY, Le Mars, Ia.; Western Union College.
KFCZ, Omaha, Neb.; 258 meters; 100 watats; Omaha Central High School.
KFDA, Baker, Ore.; Adler's Music Store.
KFDB, San Francisco, Calif.; Mercantile Trust Co.
KFDD, St. Michael Cathedral, Boise, Idaho, 252 meters, 10 watts.
KFDH, Tucson, Ariz.; Univ. of Arizona.
KFDJ, Corvallis, Ore.; Oregon Agri. College.
KFDL, Denver, Colo.; Knight Campbell Music Co.
KFDO, Bozeman, Mont.; Everett H. Cutting.
KFDP. Des Moines, Ia.; Hawkeye Radio & Supply Co.
KFDR, York, Nebraska; Bullock's Hardware & Sporting Goods.
KFDS, San Francisco, Calif.: John D. McKee.
KFDU, Lincoln, Nebr; Nebraska Radio & Elect. Co.; 240 meters; 20 watts.
KFDV, Fayetteville, Ark.: Gilbreth & Stinson.
KFDX, Shreveport, La.; First Baptist Church.
KFDY, Brookings, S. D.; South Dakota State College of Agriculture and Mechanical Arts.
KFDZ, Minneapolis, Minn.; Harry O. Iverson.
KFEC, Portland, Ore.; Meier & Frank Co.
KFEJ, Tacoma, Wash.; Guy Greason.
KFEL, Denver, Colo., Winnen Radio Corp.
KFEP, Denver, Colo., Radio Equipment Co.
KFEQ, Oak Nebraska; J. L. Scroggin.
KFER, Ft. Dodge, Iowa; 231 meters, 10 watts; Auto Electric Service Co.
KFEV, Douglas, Wyo; Radio Elect. Shop; 263 meters; 100 watts.
KFEX, Minneapolis, Minn: 261 meters, 100 watte Augsburg Seminary.
KFEY, Kellogg, Idaho; Bunker Hill & Sullivan Mining & Construction Co.
KFEZ, St. Louis, Mo.; American Society of Mechanical Engineers.
KFFA, San Diego, Calif.; Dr. B. C. Shelton.
KFFE, Pendleton, Ore.; Eastern Oregon Radio Co.
KFFO, Hillsboro, Oregon; Dr. E. H. Smith.
KFFP, Moberly, Missouri; First Baptist Church.
KFFQ, Colorado Springs, Colo.. Marksheffel Motor Co.
KFFR, Kirk, Jim, Sparks, Nev.; 226 meters, 10 watts.
KFFV, Lamont, Iowa; Graceland College.
KFFX, Omaha, Neh; 278 meters, 250 watts; The McGraw Co.
KFFY, Alexandria, La; 275 meters; 100 watts: Pincus & Murphy Inc.
KFFZ, Dallas, Texas; 226 meters, 20 watts; A. G. Barnes Amusement Co.
KFGC, Baton Rouge, La; 254 meters, 100 watts; Louisiana State Universlty.
KFGD, Chickasha, Okla.; 248 meters, 20 watts; Chickasha Radio & Elect. Co.
KFGF, Mt. Vernen, Wash.; Buchanan, Stevens & Co.
KFGH, Stanford Univ., Calif.
KFGJ, St. Louis, Mo.; 266 meters, 100 watts; Nat'l Guards Missouri 138 Infantry.
KFGL, Arlington, Oregon; Arlington Garage.
KFGP, Cheney, Kansas; 229 meters, 10 watts; Cheney Radio Company.
KFGQ, Boone, Iowa; 226 meters, 20 watts; Crary Hardware Co.
KFGV, Utica, Nebraska; 224 meters, 10 watts; Heidbreder Radio Supply Co.
KFGX, Oranze, Texas; 250 meters; 500 watts; First Presbyterian Church.
KFGY, Baudette, Minn; 224 meters, 15 watts; Gjelhavg's Radio Shop.
KFGZ, Berrien Springs, Mich; 268 meters, 10 watts; Emmanuel Missionary College.
KFHA, Gunnison, Colo.; Colorado State Normal School.
KFHB, Hood River, Oregon; P. L. Boardwell.
KFHD, St. Joseph, Mo.; 226 meters, 10 watts; Utz Electric Co.
KFHF, Shreveport, La 266 meters, 150 watts; Central Christian Church.
KFHR, Seattle, Wash; Star Elect & Radio Co; 270 meters; 100 watts.
KFHH, Neah Bay, Wash.; Ambrose McCue.
KFHI, Wichita, Kansas: 224 meters, 20 watts; Charles V. Dixon.
KFHJ, Santa Barbara, Calif., Fallon Co.
KFHL, Oskaloosa, Ia.: 227 meters, 10 watts; Penn College.
KFHP, Kearney, Nebr: Radio Bug Products Co; 246 meters; 10 watts.
KFHQ, Curtis Bros. Hardware Store, Los Gatos, Calif.; 242 meters, 5 watts.
KFHS, Dow, Clifford J., Lihue, Hawaii, 275 meters, 30 watts.
KFHS, Nelson, Robert Washington, Hutchinson. Kansas; 229 meters, 50 watts.
KFHU, Sateren, M. G., Mayville, N. D.; 261 meters, 50 watts.
KFHY, McEwan, R. S., Trinidid, Col.; 242 meters, 50 watts.
KFIB, St. Louis, Mo.: 214 meters, 10 watts; Franklin W. Jenkins.
KFID, Iola, Kansas, 246 meters, 20 watts; Ross Arbuckle's Garage.
KFIF, Portland, Ore.; Benson Tech. Student Body.
KFIJ, Platte, S. D.; Sidney I. Thorean; 236 meters; 5 watts.
KFIK, Gladbrook, Ia; Gladbrook Electric Co; 234 meters; 20 watts.
KFIO, Spokane, Wash.; North Central High School; 252 meters; 50 watts.
KFIQ, Yakima, Wash.; 224 meters, 50 watts; Yakima Valley Radio Broadcasting Association.
KFIU, Alaska Elect. Light & Power Co., Juneau, Alaska, 226 meters, 10 watts.
KFIV, Broyles, V. H., Pittsburg, Kansas; 240 meters, 20 watts.
KFIX, Reorganized Church of Jesus Christ, of Later Day Saints, Independence, Kans.; 240 meters, 500 watts.
KFIY, Seattle, Wash; 236 meters 15 watts; Brott Laboratories.
KFIZ, Fond du Lac, Wisc., 273 meters; 100 watts; Daily Commonwealth.
KFJC, Seattle, Wash.; 233 meters; 100 watts; Post Intelligencer.
KFJD, Greeley, Colo.; Weld County Printing & Publishing Co; 236 meters; 100 watts.
KFJF Oklahoma City, Okla; 252 meters; 20 watts; Nat'l Radio Co.
KFJH, Selma, Calif.; 273 meters; 10 watts; The Sugar Bowl.
KFJI, Astoria, Ore.; 252 meters; 10 watts; Liberty Theatre.
KFJJ, Carrollton, Mo.; Carrollton Radio Shop; 236 meters; 50 watts.
KFJK, Bristow, Okla.; 233 meters; 100 watts; Delano Radio Elect. Co.
KFI, Los Angeles, Calif.; radius covers entire U. S. and Canada; Daily, 6:45 to 11 p. m. Sunday 10 to 11 a. m., 4 to 4:30 and 8 to 11 p. m.; entertainment and educational features; station operates three remote control stations: Earle C. Anthony, Inc.
KFKH, Denver Park Amusement Co; Lakeside, Colo; 226 meters, 10 watts.
KFU, Gridley, Calif.: The Precision Shop.
KFZ, Spokane, Wash.; Doerr-Mitchell Elec. Co.
KGB, Tacoma, Wash.; Mon. Wed. and Fri. 7 to 9 p m, News sport bulletins, lectures, entertainment, weather, tide tables, and time. Tacoma Daily Ledger, Tacoma, Wash.
KGG, Portland, Ore.; Hallock & Watson Radio Service.
KGN, Portland, Ore.; Northwestern Radio Mfg. Co.
KGO, Altadena, Cal. 2500 miles; every Saturday 8 to 9:30 p m Musical program;
KGU, Honolulu, Hawaii, Waikiki Beach, Marion A. Mulroney; Honolulu Advertiser
KGW, Portland, Ore.; Oregonian Pub. Co.
KGY, Lacey, Wash.; St. Martin's College, (Rev. S. Ruth).
KHJ, Los Angeles, Calif.; Daily except Sunday: 12:30 p. m. to 1:15 p. m. news and concerts; 7 to 7:30 p. m. Children's Half Hour; 8 to 9:30 p. m. De Luxe program of music, news and educational features; Sunday: 10 to 11 a. m. Scripture reading, sermon, prayer and sacred musical program; Pacific time; Times-Mirror company.
KHQ, Seattle, Wash.; Louis Wasmer.
KJQ, Stockton, Calif.; C. O. Gould.
KJS, Los Angeles, Calif.; Bible Inst. of Los Angeles.
KLB, Pasadena, Calif ; J. J. Dunn & Co.
KFDC, Spokano, Wash ; Radio Supply Co.
KLN, Monterey Electric Shop, Monterey, Calif.; 261 meters, 10 watts.
KLS, Oakland, Calif.; Warner Bros.
KLX, Oakland, Calif.; Tribune Pub. Co.
KLZ, Denver, Colo.; Class B, 485, Reynolds Radio Co.
KMAZ, Macon, Ga., Mercer University.
KMC, Reedley, Calif.; Lindsay-Wetherill Co.
KMJ, Fresno, Calif. Max. 2576 Miles; Musical program, San Joaquin Light & Power Corp.
KMO, Tacoma. Wash., Love Electric Co.; Tacoma Times.
KNJ, Roswell, New Mexico; 250 meters; 150 watts; every evening at 8; news, weather reports, stock markets, concerts, sermons; Roswell Public Service Co.
KNT, Aberdeen, Wash.; North Coast Products Co.
KNV, Los Angeles, Calif.; 256 meters; 20 watts; Radio Supply Co. of Cal.
KNX Los Angeles, Calif.; Electric Lighting Supply Co.
KOB, State College, N. Mex.; time signals and weather reports 12 noon and 10: p m, mountain time; music and lectures Monday, Wednesday and Friday, 7:30 to 8:30 p m; New Mexico College of Agrieulture and Mechanical Arts.
KOE, Spokane, Wash.; Spokane Chronicle.
KOP, Detroit, Mich., Detroit Police Dept.
KOQ, Modesto, Calif., Modesto Evening News.
KPO, San Francisco, Calif., Hale Bros.
KQI, Berkeley, Calif., Univ. of California.
KQP, Hood River, Oregon; Apple City Radio Club.
KQV, Pittsburgh, Pa., Doubleday-Hill Elec. Co.
KQW, San Jose, Calif., Chas. D. Herrold.
KRE, Berkeley Daily Gazette, Berkeley, Cal.; 278 meters, 50 watts.
KSC, San Jose, Calif., O. A. Hale & Co.
KSD, St. Louis, Mo.; 1700 miles; grain, livestock, cotton, New York stocks, poultry and butter market, metal market, official weather and news at 9:40, 10:40, 11:40, 12:40, 1:40, 2:40 and 4 p m; 8: p m 400 meters, musical and other features; Pulitzer Publishing Co., St. Louis Post Dispatch.
KSS, Long Beach, Calif., Prest & Dean Radio Research Lab.
KSU, Wenatchee, Wash.
KTW, Seattle, Wash., First Presbyterian Church.
KUS, Los Angeles, Cal. 500 miles; setting up exercises daily, 7 to 7:30 a m and 12:00 noon to 12:30 p m; concert, 65 voices, 6 to 6:45 p m, Wednesdays and Fridays; City Dye Works.
KUY, Del Monte Calif., Coast Radio Co.
KUO, San Francisco, Calif., Examiner Printing Co., San Fran. Examiner.
KWG, Stockton, Cal. Daily Market reports, music and news 4 to 5 p m; Music, 2 to 3 p m, Sunday; Tuesdays and Fridays, music, 8 to 9 p m. Portable Wireless Telephone Co.
KWH, Los Angeles, Calif., Los Angeles Examiner.
KXD, Modesto, Calif., Herald Publishing Co.
KYQ, Honolulu, T. H., The Electric Shop.
KYW, Chicago, Ill.; Westinghouse Elec. & Mfg. Co. 345 meters.
KZM, Oakland, Calif., Western Radio Inst.; Preston D. Allen.
KZN, Salt Lake City, Utah, The Deseret News.
KZV, Wenatchee, Wash., Wenatchee Battery & Motor Co.
NOF, Anacostia, D. C., U. S. Navy Dept.
PWX, Havana, Cuba, Cuban Telephone Co.
WABD, Dayton, Ohio; 286 meters, 10 watts; Parker High School.
WAI, Dayton, Ohio, McCook Field, U. S. Army.
WAAB, New Orleans, La., Valdemar Jensen.
WAAC, New Orleans, La., Tulane Univ.
WAAD, Cincinnati, Ohio, Ohio Mechanics Inst.
WAAE, St. Louis, Mo., St. Louis Chamber of Commerce.
WAAF, Chicago, Ill., Chicago Daily Drovers Journal.

(*Continued on next page.*)

Complete Corrected List of U. S. and Canadian Broadcasting Stations

WAAH, St. Paul, Minn.; Commonwealth Electric Co.
WAAK, Milwaukee, Wis., Gimbel Bros.
WAAL, Minneapolis, Minn., Minnesota Tribune Co. & Anderson-Beamish Co.
WAAM, Newark, N. J, 360 miles; musical and code, every week day 11 to 11:55 a m, 3 to 4 p m; Wednesday evenings 8 to 9; I. R. Nelson Company.
WAAN, Columbia, Mo., Univ. of Missouri.
WAAP, Wichita, Kans., United Elec. Co.; Otto W. Taylor.
WAAS, Decatur, Ga., Georgia Radio Co.
WAAT, Jersey City, N. J., Jersey Review.
WAAW, Omaha, Neb., Omaha Grain Exchange.
WAAZ, Emporia, Kans.; Daylite 100 miles; nite 500-1000 miles; each Tuesday and Thursday from 7 to 8 p m. Acknowledge all communications at 7:15 p m. The Hollister Miller Motor Co.
WABB, Harrisburg, Pa; 266 meters, 10 watts; Dr. John B. Lawrence.
WABC, Anderson, Ind; 299 meters, 10 watts, Fulwider-Grimes Battery Co.
WABD, Dayton, Ohio; 286 meters, 10 watts; Parker High School.
WABE, Washington, D. C; 283 meters, 50 watts; Y. M. C. A.
WABF, Mt. Vernon, Ill; 234 meters, 250 watts; Mt. Vernon Register-News Co.
WABG, Jacksonville, Fla; Arnold Edwards Piano Co. 248 meters; 10 watts.
WABI, Bangor, Me; Bangor Railway and Elect. Co.; 240 meters; 50 watts.
WABJ, South Bend, Ind; The Radio Laboratories; 240 meters; 50 watts.
WABM, Doherty, F. E. Saginaw, Mich.; 254 meters, 100 watts.
WABD, Lake Avenue Baptist Church, Rochester, N. Y.; 252 meters, 30 watts.
WAJT, Marshall, Me., Kelly-Vawter Jewelry Co.
WAJU, Yankton, S. D., Yankton College.
WABH, Sandusky, Ohio; 234 meters, 100 watts; Lake Shore Tire Co.
WBAA, W. Lafayette, Ind., Purdue University.
WBAD, Minneapolis, Minn., Sterling Elec. Co. & Journal Printing Co.
WBAE, Peoria, Ill., Bradley Polytechnic Inst.
WBAF, Moorestown, N. J., Fred M. Middleton.
WBAG, Bridgeport, Pa., Diamond State Fibre Co
WBAK, Harrisburg, Pa.; 360 meters; Pennsylvania State Police.
WBAM, New Orleans, La., I. B. Rennyson.
WBAN, Paterson, N. J., Wireless Phone Corp.
WBAD, Decatur, Ill.; 100 miles; occasional music; sermons; James Millikin Univ.
WBAP, Fort Worth, Tex.; 4000 miles; Markets and News; Feature concert Monday to Friday inclusive; 9:30 p m to 10:45 p m, Central Time; Quiet nights Saturday and Sunday. The Star-Telegram.
WBAQ, South Bend, Ind., Myron L. Harmon.
WBAU, Hamilton, Ohio, Republican Publishing Co.
WBAV, Columbus, Ohio, Erner & Hopkins Co.
WBAW, Marietta, Ohio; Marietta College; 246 meters; 100 watts.
WBAX, Wilkes-Barre, Pa., John H. Stenger, Jr
WBBA, Newark, O.; 240 meter, 20 watts; Newark Radio Lab.
WBBC, Sterling, Ill; 229 meter, 50 watts; Sterling Radio Equipment Co.
WBBD, Reading, Pa; Barbey Battery Service; 224 meters; 50 watts.
WBL, Anthony, Kans; T & H Radio Co; 261 meters; 100 watts.
WBS, Newark, N. J.; Radius 500 mi.; Musical and Educational, week days: 10:30 to 11 a. m.; 1:00 to 1:15 p. m.; 2:15 to 2:30 p. m.; 7:30 to 8:30 p. m.; Sundays: 9 to 10:30 a m; 1 to 3 p m; D. W. May, Inc.
WBT, Charlotte, N. C. 1200 miles; 11: a m weather report 485; 4:30 p m mechanical music; 8: p m Market Report; 8:30 Tuesday and Friday regular concert; 7:30 p m Sunday, Church Southern Radio Corp.
WBU, Chicago, Ill., City of Chicago.
WBZ. Springfield, Mass., Westinghouse Elec. & Mfg. Co.
WCAD, St. Lawrence University, Canton, N. Y.; 280 meters, 50 watts.
WCAE, Pittsburgh, Pa.; 12:30 news and reports; 3:30 weatehr reports; 4:15 Closing Market reports; 7:30 Late news and lecture; 8:30 musical programs; Kaufmann Baer Co.
WCAG, New Orleans, La., Daily States Pub. Co.
WCAH, Columbus, O. Daily program 11:30 to 12:30; Every Tuesday evening at 7, musical program; C. A. Entrekin Electric Co.
WCAI, San Antonio, Texas, Southern Equipment Co.
WCAJ, Univ. Place, Neb., Nebraska Wesleyan University.
WCAK, Houston, Texas, Alfred P. Daniel.
WCAL, Northfield, Minn., St. Olaf College.
WCAM, Villanova, Pa., Villanova College.
WCAD, Baltimore, Md., Sanders & Stayman Co.
WCAP, Chesapeake & Potomac Tel. Co., Washington, D. C.; 469 meters, 500 watts.
WCAR, San Antonio, Texas, Alamo Radio Elec. Co.
WCAS, Minneapolis, Minn., Wm. H. Dunwoody Industrial Inst.
WCAT, Rapid City, S. Dak., South Dakota School of Mines.
WCAU, Philadelphia, Pa.; 1000 miles; Daily 10:30 a. m.; 2:30 p. m.; 6:30 p m; regular concert 10 to 12 noon; Tuesdays, Fridays, Saturdays; Durham & Co., Ins.
WCAV, Little Rock, Ark., J. C. Dice Elec. Co.
WCAW, Omaha, Nebr., Woodmen of the World.
WCAX, Burlington, Vermont, University of Vermont.
WCAY, Milwaukee, Wis., Kesselman O'Driscoll Co.
WCBA, Allentown, Pa.; Chas. W. Halmhach; 280 meters; 5 watts.
WCBB, Greenville. O.; 240 meters, 100 watts; K. & K. Radio Supply Co.
WCBD, Voliva, Wilhur Glenn, Zion, Ill.; 345 meters, 500 watts.
WCE. Minneapolis, Minn., Findley Elec. Co.
WCK, St. Louis, Mo., Stix Baer & Fuller.
WCM, Austin, Texas, Univ. of Texas.
WCX, Detroit, Mich., Detroit Free Press.
WDAD, Lindsburg, Kas.; Central Kansas Radio Supply.
WDAE, Tampa, Fla., Tampa Daily News.
WDAF, Kansas City, Mo; Kansas City Star; 411 meters; 500 watts. Regular concerts on Mon, Wed. and Fri. nights from 8 to 9:30. Concerts from 3:30 to 4:30 p m each afternoon except Sun. Baseball scores 3:25, 4:00, 4:30, 5:00, and 5:50 p. m. Marketgram and weather forecast 5:55 nightly, except Sun. Educational features and musical program 6 to 7 o'clock each night except Sunday. "Nighthawk" Frolic, Coon Sanders orchestra at the Hotel Muehlebach nightly except Sun. 11:45 p. m. to 1 a. m.
WDAG, Amarillo, Texas, K. Laurence Martin.
WDAG, Brownsville, Pa., Hartman-Riker Elec. & Mach.Co.
WDAH, El Paso, Tex.; Trinity Methodist Church.
WDAJ, Ervins El. Co., Parson's, Kan. 258 meters, 15 watts.
WDAI, Syracuse, N. Y., Hughes Electrical Corp.
WDAK, Hartford, Conn., Hartford Courant.
WDAL, Jacksonville, Fla., Florida Times Union.
WDAO, Dallas, Texas, Automotive Elec. Co.
WDAP, Chicago, Ill., markets, and concerts 360; Daily on all business days: 9:30 a. m. receipts and shipments; estimated car lots; local weather report; opening futures market in wheat, corn, oats, rye, barley, pork, lard and ribs. 10 a. m. Future quotations, live stock receipts and prices; 10:30 a. m. futures quotations; 11 and 11:30 a m. same; 12 noon, futures and cash grain prices; 12:30 and 1 p. m. futures quotations; 1:20 p. m. closing futures quotations and high and low for day. Cash grain prices. Gross hide for cash grain to arrive. 6 p. m. closing quotations; news items. On Saturdays closing prices at 12:05 p. m. instead of 1:20 p. m. Visible supply changes sent when posted. Regular concert schedule 10 p. m. Tuesdays, Thursdays and Saturdays. Sunday evenings 9 p. m. and 10 p. m. Chicago Board of Trade official station.
WDAR, Philadelphia, Pa.; Lit Brothers.
WDAS, Worcester, Mass., Samuel A. Waite.
WDAU, New Bedford, Mass., Slocum & Kilburn
WDAX, Centerville, Iowa; First National Bank 268 meters, 100 watts.
WDAY, Fargo, N. D.; 244 meters, 50 watts; Fargo Radio Service Co.
WDBF, Phillips, Robert G., Youngstown, Ohio; 261 meters, 50 watts.
WDM, Washington, D. C., Church of the Covenant.
WDT, New York, N. Y., Ship Owners Radio Service.
WDZ, Tuscola, Ill., James L. Rush.
WEAA, Fallain & Lathrop, Flint, Mich.; 280 meters; 150 watts.
WEAB, Fort Dodge, Iowa, Standard Radio Equip. Co.
WEAD, Atwood, Kans., Northwest Kansas Radio Supply Co.
WEAE, Blacksburg, Va., Virginia Polytechnic Inst.
WEAF, New York City, N. Y., Western Electric Co.
WEAG, Edgewood, R. I., Nichols-Hinelline-Bassett Lab.
WEAH, Wichita, Kans.; 244 meters; 100 watts; Wichita Bd of Trade.
WEAI, Ithaca, N. Y., Cornell University.
WEAJ, Vermillion, S. Dak., University of South Daketa.
WEAK, St. Joseph, Mo., Julius B. Abercrombie.
WEAM, North Plainfield, N. J., Burough of N. Plainfield
WEAN, Shepard Co., The, Providence, R. I.; 273 meters, 100 watts.
WEAO, Columbus, Ohio, Ohio State University.
WEAP, Mobile, Ala., Mobile Radio Co.
WEAQ, Berlin, N. H., Y. M. C. A.
WEAR, Baltimore, Md., Balt. American & News Pub. Co
WEAS, Washington, D. C., The Hecht Co.
WEAU, Sioux City, Iowa, Davidson Bros. Co.
WEAY, Houston, Texas, Will Horwitz, Jr.
WEAZ, Waterloo, Iowa, Donald Redmond.
WEB, St Louis, Mo., The Benwood Co., Inc
WEV, Houston, Texas, Hurlburt-Still Elec. Co.
WEW, St. Louis, Mo., Market and weather reports at 9 a. m., 10 a. m., and 2: p m; no other regular program; St. Louis University.
WEY, Wichita, Kansas, Cosradio Co.
WFAA, Dallas, Texas. A. H. Belo & Co.
WFAB, Syracuse, N. Y., C. F. Weose.
WFAC, Superior, Wis., Superior Radio Co.
WFAF, Poughkeepsie, N. Y., H. C. Spratley Radio Co.
WFAH, Port Arthur, Texas, Elec. Supply Co.
WFAJ, Asheville, N. C., Hi-Grade Wireless Instrument Co.
WFAK, Brentwood, Mo., Domestic Electric Co.
WFAM, St. Cloud, Minn., Granite City Elec. Co. and Times Pub. Co.
WFAN, Hutchinson, Minn., Hutchinson Electric Service Co.
WFAQ, Cameron, Mo., Cameron Radio Co. and Mo. Wesleyan College.
WFAT, Sioux Falls, S. Dak.; also Argus-Leader.
WFAV, Lincoln, Nebr., Univ. of Nebr. Dept. of Elec. Engineering.
WFI, Philadelphia, Penn., also Strawbridge & Clothier.
WGAC, Brooklyn, N. Y., Orpheum Radio Stores Co.
WGAD, Ensenada, Porto Rico, Spanish-American School of Radio-telegraphy.
WGF, Des Moines, Iowa 300 miles; Musical and entertainment Tuesday and Friday 7:30 p m; Church Services Sunday at 5 p m or 7:45 p m as announced; Special programs as announced Register and Tribune.
WGAJ, Shenandoah, Iowa, W. H. Gass.
WGAL, Lancaster, Pa.; Lancaster Elect. Supply Co. 248 meters; 10 watts.
WGAN, Pensacola, Fla., Cecil E. Lloyd.
WGAQ, Shreveport, La., Glenwood Radio Corp.
WGAR, Fort Smith, Ark., Southwest American.
WGAU, Wooster, Ohio; 226 meters, 20 watts; Marcus G. Limb.
WGAV, Savannah, Ga., B-H Radio Co.
WGAW, Altoona, Pa., Ernest C. Alhright.
WGAY, Madison, Wis., North Western Radio Co.
WGAZ, South Bend, Ind., South Bend Tribune.
WGI, Medford Hillside, Mass., Am. Radio & Researcb Corp.
WGL, Philadelphia, Pa., Thos. F. J. Howlett.
WGM, Atlanta, Ga., Atlanta Constitution.
WGR, Buffalo, N. Y., Federal Tel. & Teleg. Co.
WGV, New Orleans, La., Interstate Elec. Co.
WGY, Schenectady, N. Y., General Elec. Co.
WHA, Madison, Wis., Univ. of Wis.
WHAA, Iowa City, Ia; 500 miles; 8:30 p m, Monday, instruction; Tuesday, concert; Wednesday, popular lecture; Friday, University News; public lectures and concerts irregularly; State University of Iowa.
WHAB, Galveston, Texas, Clark W. Thompson (Fellman's Dry Goods Co.)
WHAC, Waterloo, Iowa, Cole Bros. Elec. Co.
WHAD, Marquette Univ., Milwaukee, Wis.; 280 meters, 100 watts.
WHAG. Cincinnati, Ohio, Univ. of Cincinnati.
WHAH, Joplin, Mo; radius, 1384 mi.;Concerts, markets, weather, etc. Tuesday and Thursday evenings; 8 to 10; Daily except Sundays: 10 a. m. to 2 p. m.; Saturday night special: 11 to 12:30; Hafer Supply Co.
WHAI, Davenport, Iowa, Radio Equip. & Mfg. Co.
WHAJ, Bluefield, W. Va., Bluefield Daily Telegraph and E. K. Kitts.
WHAK, Clarksburg, W. Va., Roberts Hdwe. Co.
WHAL, Lansing, Mich., Lansing Capitol News.
WHAM, Rochester, N. Y. Daily—Weather reports 2:40 p. m.; Organ 2:45, 5:00, 6:45; Orchestra 3:00, 7:00; Bed-time stories, Sport results, Business reports and market reports, the latter on 485 meters, 7:15 p m; Sunday—Radio Chapel Service, 3:15 p m; University of Rochester.
WHAD, Savannah, Ga., Frederick A. Hill; every evening 8 to 9; Saturday nights, 12:30 1:30 a. m.
WHAP, Decatur, Ill., Dewey L. Otta.
WHAQ, Washington, D. C., Semmes Motor Co.
WHAR, Paramount Radio & Elect. Co., Atlantic City, N. J.;231 meters, 15 watts.
WHAS, Louisville, Ky., Courier Journal and Louisville Times Co.
WHAV, Wilmington, Del., Wilmington Elec. Spec. Co.
10 p m Wednesday evenings; Central Standard time; Iowa Radio Corp.
WHAY, Huntington, Ind., Huntington Press.
WHAZ, Troy, N. Y., Rensselaer Polytechnic Inst.
WHB, Kansas City, Mo., Sweeney Auto & Tractor School.
WHD, Morgantown, W. Va., W. Va. University.
WHK, Cleveland, Ohio, Warren R. Cox.
WHN, Ridgewood, N. Y., Times Printing & Pub. Co.
WHU, Toledo, Ohio, Wm. B. Duck Co.
WHX, Des Moines, Iowa; 300 miles; 5:45 p m to 6:15 p m Daily; 8:00 p m to
WIAB, Joslyn Automobile Co., Rockford, Ill.; 252 meters, 50 watts.
WIAC, Galveston, Texas, Galveston Tribune.
WIAD, Ocean City, N. J., Ocean City Yacht Club.
WIAF, New Orleans, La; G. A. DeCortin, 10 Marlborough Gate; 234 meters, 10 watts.
WJAG, Norfolk, Nebr; 200 miles News and Markets 12:15, 3:30 and 5:30 p. m The Huse Publishing Co. The Norfolk Daily News.
WIAH, Newton, Iowa, Continental Radio & Mfg. Co.
WIAI, Springfield, Mo., Heer Stores Co.
WIAJ, Neenah, Wis., Fox River Valley Radio Supply Co.
WIAK, Omaha, Nebr.; 7:45 a. m. Livestock receipts; 9:10 a. m. Livestock receipts and opening on hogs; 10:15 a m rainfall and temperature report and weather forecast for Nebraska and Iowa, Livestock market; 12 m cattle, hog and sheep market; 1:50 p m rainfall and temperature report and weather forecast for Nebraska and Iowa; market detail; 3:50 p m complete market reports and estimated receipts for next day; Daily Journal-Stockman.
WIAD, Milwaukee, Wis., School of Engineering.
WIAP, Springfield, Mass., Radio Development Corp
WIAQ, Marion, Ind.; 226 meters; 10 watts; Chronicle Publishing Co.
WIAR, Paducah, Ky., Musical 3:30 to 4 p. m. and 7 to 8 p. m. except Sundays Paducah Evening Sun: Albert Bennett, operator.
WIAS, Burlington, Iowa, Hawk-Eye Home Elec. Co.
WIAT, Tarkio, Mo., Leon T. Noel.
WIAU, Le Mars, Iowa, Am. Trust & Savings Bank
WIAY, Neenah, Wis; 224 meter, 100 watts; Fox River Valley Radio Supply Co.
WIK, McKeesport, Pa., K. & L. Elec. Shop.
WIL, Washington, D. C., Continental Elec. Supply Co.
WIP. Philadelphia, Pa., Gimbel Bros.
WJAB, Lincoln, Nebr., American Radio Co.
WJAD, Waco, Texas. Jackson's Radio Engrng. Lab.
WJAF, Muncie, Ind; 1800 miles; 7:30 to 8 Monday, Wednesday, Friday evening music; 6:30 to 7 p m Saturday, music; 3:30 to 4 every afternoon, News; 10:30 to 12 M Sundays, Church service. Smith Electric-Muncie Press.

(Continued on next page.)

Complete Corrected List of U. S. and Canadian Broadcasting Stations

WJAK, Stockdale, Ohio White Radio Lab.
WJAM, Cedar Rapids, Ia; D. C. Perham, 268 meters, 20 watts.
WJAN, Peoria, Ill; 280 meters, 100 watts; Daily except Sunday: 9 a. m. Peoria Livestock; 9:15 a. m. Special Weather Information; 11:30 a. m. weather, opening livestock and market quotations; 1:30 p. m. Closing livestock and markets, official weather information; talk to women by Phyills Ann; Monday and Thursday, government agriograms; 5:30 p. m. baseball reports during season; Tuesday, Thursday and Saturday, special concerts as announced at 9:15 p. m.; One musical number preceeds each broadcasting. Peoria Evening Star.
WJAP, Duluth, Minn. 1500 miles; Sunday 11 a m. 12:30 p m Church Service and organ recital; First Methodist Church, Rev. Chas. N. Pace, Pastor. Monday 8: p m to 9 p m, musical; Thursday 8 p m to 9 p m. musical; Kelley Duluth Co.
WJAQ, Topeka, Kans., Capper Publications.
WJAR, Providence, R. I., The Outlet Co., J. Samuels & Bros.
WJAS, Pittsburgh, Pa., Pittsburgh Radio Supply House.
WJAT, Marshall, Mo., Kolley-Vawter Jewelry Co.
WJAX, Cleveland, Ohio, Union Trust Co.
WJAZ, Chicago, Ill., Chicago Radio Lab.
WJD, Granville, Ohio; 229 meters, 50 watts; Richard Harris Howe.
WJH, Washington, D. C., White & Boyer Co.
WJX, New York, N. Y., De Forest Radio Telephone & Teleg. Co
WJZ, New York, Radio Corp. of America; Aeolin Hall, 455 meters.
WKAA, Cedar Rapids, Ia.; Daily; weatther reports, crop reports, government reports; Mondays, Thursdays and Saturdays: music; H. F. Paar.
WKAC, Lincoln, Nebr; Star Publishing Co; 275 meters; 100 watts.
WKAD, Looff, Charles, East Providence, R.I.; 240 meters, 10 watts.
WKAF, Wichita Falls, Texas, W. S. Radio Supply Co.
WKAN, Montgomery, Ala., Alabama Radio Mfg. Co.
WKAP, Cranston, R. I., Dutee W Flint.
WKAQ, Sao Juan, Porto Rico, Radio Corp. of Porte Rico
WKAR, Michigan Agrl. College, East Lansing, Mich., 280 meter. 100 watts.
WKAS, Springfield, Mo., L. E. Lines Music Co.
WKAV, Laconia, N. H., Laconia Radio Club.
WKAW, Beloit, Wis; 242 meters, 10 watts; Turner Cycle Co.
WKAX, Bridgeport, Pa; W. A. McFarlane; 231 meters; 15 watts.
WKAY, Gainesville, Ga., Brenau College.
WKC, Baltimore, Md., Jos. M. Zamoiski Co.
WKY, Oklahoma City, Okla., Oklahoma Radio Shop.
WLAC, Raleigh, N. C., N. C. State College.
WLAG, Minneapolis, Minn., Cutting & Walsh Radio Corp.
WLAH, Syracuse, N. Y., Samuel Woodworth.
WLAJ, Waco, Texas, Waco Elec. Supply Co.
WLAK, Bellows Falls, Vt., Vermont Farm Machine Co.
WLAL, Tulsa, Okla., Tulsa Radio Co.
WLAN, Houlton, Me.; 283 meters; 250 watts; Putnam Hardware Co.
WLAP, Louisville, Ky., W. V. Jordan.
WLAQ, Kalamazoo, Mich., A. E. Schilling.
WLAT, Burlington, Iowa, Radio Specialty Co.
WLAV, Pensacola, Fla.; daily musical program, 8 to 9 p m; The Electric Shop.
WLAW, New York, N. Y., New York Police Dept.
WLAX, Greencastle, Ind., Greencastle Community Broadcasting Station.
WLAY, Fairbanks, Alaska, Northern Commercial Co.
WLAZ, Warren, Ohio, Hutton & Jones Elec. Co.
WLB, Minneapolis, Minn., Univ. of Minn.
WLW, Cincinnati, Ohio, Crosley Mfg. Co.
WLZ, Fairfield, Ohio, U. S. Army.
WMA, Anderson, Ind., Arrow Radio Lab.
WMAB, Oklahoma City, Okla., Radio Supply Co.
WMAC, Cazenovia, N Y; J. Edw. Page; 261 meters; 50 watts.
WMAE, Dartmouth, Mass., Round Hills Radio Corp.
WMAH, Lincoln, Nebr., General Supply Co.
WMAJ, Kansas City, Mo., Drovers Telegram.
WMAK, Lockport, N. Y., Norton Labs.
WMAL, Trenton, N. J, 100 miles; 7:30 to 9 p m, Mondays and Thursdays, musical programs, lectures etc; Trenton Hardware Co.
WMAN, First Baptist Church, Columbus, Ohio; 286 meters; 20 watts.
WMAN, Columbus, Ohio, First Baptist Church.
WMAP, Easton, Pa., Utility Battery Service.
WMAQ, Fair Store Building, Chicago; 4:35 to 5 p m, daily; 7 to 7:30 p m, Monday, Wednesday, Friday and Saturday; 7 to 8 p m, Tuesday and Thursday; 9:15 to 10 p m daily; Chicago Daily News and Fair Department Store
WMAT, Paramount Radio Corp., Duluth Minn.; 266 meters, 25 watts.
WMAV, Auburn, Ala., Polytechnic Inst.
WMAZ, Macon, Ga., Mercer University.
WMAY, St. Louis, Mo.; 280 meters, 10 watts; religious services, Sunday 11 a. m. and 8 p. m. Tuesday at 7 p. m. Kingshighway Presbyterian Church.
WMC, Memphis Commercial Appeal; Memphis, Tenn.
WMH, Cincinnati, Ohio, Precison Equipment Co.
WMU, Washington, D. C., Doubleday-Hill Electric Co.
WNAC, Boston, Mass.; Monday 4 to 5 p. m. (silent at night) Tuesday 4 to 5 p. m. and 7 to 8:30 p. m. Wednesday 4 to 5 p. m. 9:30 to 11 p. m. Thursday 4 to 5 and 7 to 8:30 p. m. Friday 4 to 5 and 8 to 9:30 p. m. Saturday 4 to 5 and 9:30 to 11 p. m. The Shepard Stores; J. J. Fanning, announcer Samuel Curtis, operator, 278 meter, 100 watts.
WNAD, Norman, Okla., Okla. Radio Engineering Co.
WNAL, Omaha, Nebr., R. J. Rockwell.
WNAN, Syracuse, N. Y., Syracuse Radio Telephone Co.
WNAP, Springfield, Ohio, Wittenberg College.
WNAQ, Charleston, S. C., Charleston Radio Elec. Co.
WNAS, Austin, Texas, Radio Corp.
WNAT, Philadelphia, Pa. 1000 miles; Talks, Radio information, music, Chapel Service. Wednesday 7:30 p m; Saturday 7.30 p m; Sunday 2:30 and 4:30; Every day 12:15, 1 p m. Lennig Bros. Co.
WNAV, Knoxville, Tenn., People's Tel. and Tel. Co.
WNAW, Fortress Monroe, Va., Henry Kunzman.
WNAX, Yankton, S. Dakota; 244 meters, 100 watts: Dakota Radio Apparatus Company.
WNAY, Baltimore, Md., Shipowners' Radio Service.
WNJ, Albany, N. Y., Shotton Radio Mfg. Co., Inc.
WOAA, Ardmore, Okla.; radius 1,500 miles; Tuesdays and Fridays: musical and educational programs; Dr. Walter Hardy; station operated by G. H. Reitz.
WOAB, Grand Forks, N. D.; 280 meters; 10 watts; Valley Radio Co.
WOAC, Lima, Ohio, Maus Radio Co.
WOAE, Fremont, Nebr., Medland College.
WOAF, Tyler, Texas, Tyler Commercial College.
WOAH, Charleston, S. C., Palmetto Radio Corp.
WOAI, San Antonio, Tex; 385 meters; Southern Equipment Company; Programs Daily; 10:30 a m Opening markets, U S weather forecast, crop reports, road reports, cotton reports, money market, livestock quotations and news bulletins, daily except Sun. 12:15 n m. Livestock quotations, produce markets, and news bulletins. 3 p m Closing markets, cotton reports, grain and market futures and news bulletins. 7 p m Complete baseball scores from American National and Texas leagues, final reports on markets, and news bulletins. Daily except Sun. 9:30 to 10:30 p m Concerts. Thurs. 7:30 to 8:30 p m Musical and Community Programs. Sunday 11:00 a m Church Services, 5:00 to 6:00 p m Concerts.
WOAJ, Parsons, Kans., Erving's Electrical Co.
WOAK, Frankfort, Ky., Collins Hardware Co.
WOAL, Webster Groves, Mo., Wm. E. Woods.
WOAN, Lawrenceburg, Tenn., James D. Vaughan.
WOAO, Omaha, Nebr. 100 miles; Woodmen of the World.
WOAQ, Portsmouth, Virginia; Portsmouth Kiwanis Club.
WOAR, Kenosha, Wis., Henry P. Lundskow.
WOAT, Wilmington, Del., Boyd Martell Hamp.
WOS, Jefferson City, Mo. Missouri State Marketing Bureau; 441 meters, 500 watts; first fifteen minutes of every hour from 8 a. m. to 2 p m.; markets and music at 5 p. m. Monday, Wednesday and Friday nights, 8 to 9:30 concerts. No Sunday program.
WOAV, Erie, Pa., Pa. Nat'l Guard.
WOAW, Omaha, Neb., 100 miles, Woodmen of the World.
WOAX, Trenton, N. J., Franklin J. Wolff.
WOAZ, Stanford, Texas, Penick Hughes Co.
WOC, Davenport, Ia. time signals, 10:55 a. m.; weather 11 a. m.; 360 motera, 11:05 opening market quotations, agriograms; 12:00 noon, chimes concert; 2:00 p m, closing stocks and markets; 3:30 p m, educational talk; 5:45 p m chimes concert; 6:35, sandman's visit; 7:00 musical program; 8 p m, lecture; Sundays, religious and musical and religious features, 9 a m to 10 p m; Palmer's School of Chiropractic.
WOI, Ames, Ia., Iowa State College.
WOK, Pine Bluff, Ark., concerts Tuesday and Friday evenings beginning at 9; Sundays, song service and sermons from churches at 11 a. m. and 7:30 p. m., Arkansas Light & Power Co.
WOO, Philadelphia, Pa., John Wanamaker.
WOQ, Kansas City, Mo., Western Radio Co.
WOR, Newark, N. J., L. Bamberger & Co.
WOV, Omaha, Nebr., E. B. Howell.
WPA, Fort Worth, Texas, Fort Worth Record.
WPAB, State College, Pa.
WPAC, Okmulgee, Okla., Donaldson Radio Co.
WPAD, Chicago, Ill., Wieboldt & Co.
WPAF, Council Bluffs, Iowa, Peterson's Radio Co.
WPAG, Independence, Mo., Central Radio Co.
WPAH, Waupaca, Wis., Wisconsin Dept. of Markets.
WPAJ, New Haven, Conn., Doolittle Radio Corp.
WPAK, Fargo, N. D., North Dakota Agricultural College.
WPAL, Columbus, Ohio, Superior Radio & Tel. Equip. Co.
WPAM, Topeka, Kans., Awerbach & Guettel.
WPAP, Winchester, Ky., Theo. D. Phillips.
WPAQ, Frosthurg, Md., General Sales & Eng. Co.
WPAQ, Wilmington, Del., Radio Installation Co., Inc.
WPAR, Beloit, Kans., R. A. Ward.
WPAT, El Paso, Texas, St. Patrick's Cathedral.
WPAU, Moorhead, Minn., Concordia College.
WPAZ, Charleston, W. Va., Dr. John R. Koch.
WFG, New Lebanon, O. Nushawg Poultry Farm; 234 meters, 50 watts.
WQAA, Parkersburg, Pa. 1500 miles; 10:30 p m every evening. Horace A. Beals, Jr.
WQAB, Springfield, Mo., Southwest Missouri State Teachers' College.
WQAC, Amarillo, Texas, E. B. Gish.
WQAD, Waterbury, Conn., Whitall Electric Co.
WQAE, Moore Radio News Station, Springfield, Vermont; 275 meters, 50 watts.
WQAF, Sandusky, Ohio, Sandusky Register.
WQAH, Lexington, Ky. Brock-Anderson Elect. Eng Co.
WQAL, Cole County Tel. & Tel. Co., Mattoon, Ill.; 258 meter, 10 watts.
WQAM, Miami, Fla., Electrical Equipment Co.
WQAN; "The Voice of Anthracite," 280 meters, 150 watts; Scranton Times, Scranton, Pa., musical and informative programs thrice daily; 12:30, 4:30 and 7:30 p. m. except Sunday. Music, news, weather forecasts and reports baseball scores, market quotations, evening bedtime stories. Special musical programs by vaudeville and other artists on Tuesday and Friday evenings at 8 p. m.
WQAO, New York, N. Y., Calvary Baptist Church.
WQAP, Lincoln, Nebr., Am. Radio Co.
WQAQ, Abilene, Texas West Texas Radio Co.
WQAR, Muncie Ind., Press Publishing Co.
WQAS, Lowell, Mass.; Prince-Walter Company.
WQAV, Huntington & Guerry, Inc., Greenville, S. C.; 258 meters, 15 watts.
WQAW, Washington, D C; Catholic University of America; 236 meters; 50 watts.
WQAX, Peoria, Ill.; Radio Equipment Co.
WQAY, Hastings, Nebr., Gaston Music & Furniture Co.
WQAZ, Greensboro, North Carolina; Greensboro Daily News.
WRAA, Houston, Texas, Rice Institute.
WRAB, Savannah, Ga.; Savannah Board of Public Education.
WRAF, Laporte, Ind; 224 meters, 10 watts; Radio Club, Inc.
WRAD, Marion, Kas.; 248 meters; 10 watts; Taylor Radio Shop.
WRAH, Providence, R. I.; Stanley N. Read.
WRAL, St. Croix Falls, Wis.; Northern States Power Co.
WRAM, Carthage, Ill., Robert E. Compton & Carthage College.
WRAN, Grover, Waldo C., La Crosse, Wis.; 234 meters, 100 watts.
WRAO, St. Louis, Mo., Radio Service Co.
WRAP, Winter Park, Fla.; Winter Park Electric Construction Co.
WRAR, Davld City, Nebr; J. C. Thomas; 226 meters; 20 watts.
WRAS, McLeansboro, Ill.; Radio Supply Co.
WRAU, Amarillo, Texas, Daily News.
WRAV, Yellow Springs, O., Antioch College.
WRAW, Good, Horace D., Reading, Pa.; 238 meters, 10 watts.
WRAX, Flexon's Garage, Gloucester City, N. J.; 268 meters, 50 watts.
WRAY, Scranton, Pa.; radius 400 mi.; Sunday Chapel service; Wednesday: Selective Musical program, 8:15 to 10; Saturday; 8:15 to 11; Radio Sales Corp., 280 meters, 100 watts.
WRAZ, Radio Shop of Newark, Newark, N. J. 233 meters, 50 watts.
WRC, Washington, D. C.; Radio Corporation of America, 469 meters, 500 watts.
WRK, Hamilton, Ohio, Doron Bros. Elec. Co.
WRL, Schenectady, N. Y., Union College.
WRM, Urbana, Ill., Univ. of Ill.
WRP, Camden, N. J., Federal Inst. of Radio Telg.
WRR, Dallas, Texas, City of Dallas, Police and Fire Signal Dept.
WRW, Tarrytown, N Y; Tarrytown Radio Research Lab; 275 Meters; 50 watts.
WSAB, Cape Girardeau, Mo., Southeast Mo. State College.
WSAC, Clemson College, S. C.; Clemson Agricultural College.
WSAG, Davis, Loren V., St. Petersburg, Fla.; 244 meters, 10 watts.
WSAH, Chicago, Ill.; A. G. Leonard, Jr.; 248 meters, 500 watts.
WSAJ, Grove City, Pa., Grove City College.
WSAK, Daily News, The, Middleport, Ohio; 258 meters, 20 watts.
WSAL, Brookville, Ind.; Franklin Electric Co.
WSAN, Allentown Radio Club, Allentown, Pa.; 229 meters, 10 watts.
WSAP, New York City; Seventh Day Adventist Church.
WSAQ, Round Hills Radio Corp., Dartmouth, Mass.; 280 meters, 100 watts.
WSAR, Doughty & Welch Elect. Co., Fall River, Mass.; 254 meters, 10 watts.
WSAT, Plainview Elect. Co., Plainview, Texas; 268 meters; 20 watts.
WSAU, Chesham, N. H.; 229 Meters: 10 watts; Camp Marlenfield.
WSAW, Canandaigua, N. Y.; 275 Meters; 100 watts; Curtice & McElwee.
WSB, Atlanta, Ga., Atlanta Journal.
WSL, Utica, N. Y., J. & M. Elec. Co.
WSY, Birmingham, Ala., Alabama Power Co.
WTAB, Fall River Daily Herald, Rall River, Mass.; 248 meters, 10 watts.
WTAC, Johnstown, Pa., Penn. Traffic Co.
WTAD, Carthage, Ill.; 229 meters; 50 watts; Robert E. Compton.
WTAF, New Orleans, La.; 242 meters; 20 watts; Louis J. Gallo.
WTAS, Elgin, Ill; 275 meters, 500 watts; Chas. E. Erbstein.
WTAU, Tecumseh, Neb., Ruegy Battery & Elec. Co.
WTAW, College Station, Texas; Ag'c'lle & Mech. College; 254 meters; 50 watts.
WTG, Manhattan, Texas, Kans. State Agri. College.
WVP, New York, N. Y. Signal Corps, U. S. Army.
WWAC, Waco, Tex; 3000 miles; Weather forecasts 11 a m daily; musical concerts, daily, 1:30 p m and on Wednesday and Saturday evenings at 8; Sanger Bros.
WWAD, Philadelphia, Pa., Wright & Wright, Inc.
WWAX, Laredo, Texas, Worman Bros.
WWB, Daily News Print Co., Canton, Ohio; 268 meters, 200 watts.
WWI, Dearborn, Mich., Ford Motor Co.
WWJ, Detroit, Mich., Evening News.
WWL, New Orleans, La.; Loyola University; 280 meters; 100 watts.

(Continued on page 32)

Complete Corrected List of U. S. and Canadian Broadcasting Stations

Canadian Stations

CFAC, Calgary, Alta., Can. Western Radio Co., Ltd.
CFCA, Toronto, Ont., Can. Toronto Star.
CFCB, Vancouver, B. C., Can. Marconi Co.
CFCE, Halifax, N. S., Can. Marconi Co.
CFCF, Montreal, P. Q., Can. Marconi Co.
CFCH, Iroquois Falls, Ont., Can. Abitibi Power & Paper Co.,, Ltd.
CFCI, Walkerville, Ont., Can. Motor Products Corp.
CFCN, Calgary, Alta., Can. W. W. Grant Radio, Ltd.
CFCX, London, Ont., Can. The London Advertiser.
CFPC, Fort Frances, Ont., Can. International Radio Develop. Co.
CFTC, Toronto, Ont., Can. The Bell Telephone Co.
CFYC, Vancouver, B. C., Can. Victor Wentworth Odium.
CFZC, Montreal, Que., Can. Can. Westinghouse Co., Ltd.
CHBC, Calgary, Canada. W. W. Grant Radio, Ltd. (Morning Albertan.)
CHCA, Vancouver, B. C., Can. Radio Corp. of Vancouver, Ltd.
CHCB, Toronto, Can. Marconi Co.
CHCC, Edmonton, Alta., Can. Can. Westinghouse Co., Ltd.
CHCF, Winnipeg, Man., Can. Radio Corp. of Winnipeg, Ltd.
CHCQ, Calgary, Alta., Can. Western Radio Co., Ltd.
CHCS, London, Ont., Can. London Radio Shoppe.
CHCX, Montreal, Que., Can. B. L. Silver.
CHCZ, Toronto, Ont., Can. Globe Printing Co.
CHOC, Vancouver, B. C., Can. Can. Westinghouse Co., Ltd.
CHVC, Toronto, Canada. Metropolitan Motors Co.
CHXC, Ottawa, Ont., Can. J. R. Booth, Jr.
CHYC, Montreal, Que., Can. Northern Elec. Co.
CJBC, Montreal, Que., Can. Dupuis-Freres.
CJCA, Edmonton, Alta., Can. Edmonton Journal, Ltd.
CJCB, Nelson, B. C., Can. James Gordon Bennett.
CJCD, Toronto, Can., T. Eaton, Co.
CJCE, Vancouver, B. C., Can. Vancouver Sun.
CJCF, Kitchener, Ont., Can. News Record, Limited.
CJGG, Winnipeg, Canada. Manitoba Free Press.
CJCH, Toronto, Ont., Can. United Farmers of Ontario.
CJCI, St. John, N. B., Can. McLean, Holt & Co., Ltd.
CJCN, Toronto, Ont., Can. Simons, Agnew & Co.
CJCS, Halifax, N. S., Can. Eastern Telephone & Telegraph Co.
CJCY, Calgary, Alta., Can Edmund Taylor.
CJGC, London, Ont., Can. London Free Press.
CJNC, Winnipeg, Man., Can. Tribune Newspaper Co.
CJSC, Toronto, Ont., Can. Evening Telegram.
CKAC, Montreal, Can. La Presse.
CKCB, Winnipeg, Man. Can. T. Eaton Co., Ltd.
CKCD, Vancouver, B. C., Can. Vancouver Daily Province.
CKCE, Toronto, Ont., Can. Can. Ind. Telephone Co.
CKCK, Regina, Sask., Can. Leader Pub. Co.
CKCR, St. John, N. B., Can. Jones Elec. Radio Co., Ltd.
CKCS, Montreal, Que., Can. The Bell Telephone Co.
CKCZ, Toronto, Ont., Can. Westinghouse Co., Ltd.
CKKC, Toronto, Ont., Can. Radio Equipment & Supply Co., Ltd.
CKOC, Hamilton, Ont., Can Wentworth Radio Supply Co., Ltd.
CKQC, London, Ont., Can. Radio Supply Co.
CKZC, Winnipeg, Man., Can. Salton Radio Eng. Co.

Radio Frequency Tuner

(*Continued from page 7.*)

The mounting and arrangement of the apparatus is clearly shown in Figure 1.

Vernier condensers should be used and should be of a low loss type, in order that they enable the builder to tune closely.

The grid condenser is connected directly across the grid and plate terminals of the tube sockets and the grid leak of the tubular type is mounted as shown.

All connections should be short, and should be soldered with flux and wiped with alcohol after the soldering is completed.

The two tube sockets are mounted directly in front of the peep slots in the panel, permitting the operator to observe the brilliancy of the valve filaments while they are in use.

The rheostats should be of proper design for the tubes used, the first for the radio frequency amplifier requiring no vernier. The detector rheostat should however include this highly desirable feature.

The 35-turn coil used in the filter arrangement in the plate circuit should be a 30 or 35-turn honeycomb coil or may be homemade, using a cardboard or bakelite tube, three and one-half inches in diameter, wound with the required number of turns, using No. 20 D C C wire. It is mounted by soldering it directly to the connecting leads which are in turn soldered to the proper points on the 23-plate condenser. If tinned copper bus bar is used in connecting up the set, it will furnish ample rigidness to hold the coil in place.

All radio frequency circuits require the use of a potentiometer to correctly control the grid bias. The potentiometer is mounted directly over the phone jack in the upper left-hand corner of the panel as shown.

Battery posts are mounted on a strip of bakelite on the back of the mounting board and the cabinet is slotted to allow this strip to slide into the back. This keeps all unsightly connecting wires away from the view of the operator.

If an amplifier is to be added, it may be constructed according to instructions in the August issue of RADIO AGE. The single circuit jack shown is substituted for by a double circuit jack and the two center springs on the double circuit jack should be connected to the binding posts P and B as shown in Figure 1, page six of the August issue. Otherwise they are connected to the P and B terminals of the first transformer of the audio frequency amplifier.

This circuit gives the best results when a U V 301 or C 301 is used as an amplifier, and a C or U V 300 is used as a detector. The merits of a U V 201 A tube as an audio frequency amplifier are unsurpassed but the results obtained when it is used as a radio frequency amplifier are not particularly gratifying.

If the operator wishes to make the set a regenerative one, a variometer may be placed in the plate circuit between the tube socket connection marked P and the phone jack. Regeneration when used with radio frequency does not always give gratifying results, and the experiment is left entirely to the judgment of the builder.

The tuning of the set requires patience as the set tunes very closely and intelligent operation is the only certain method in which results may be obtained.

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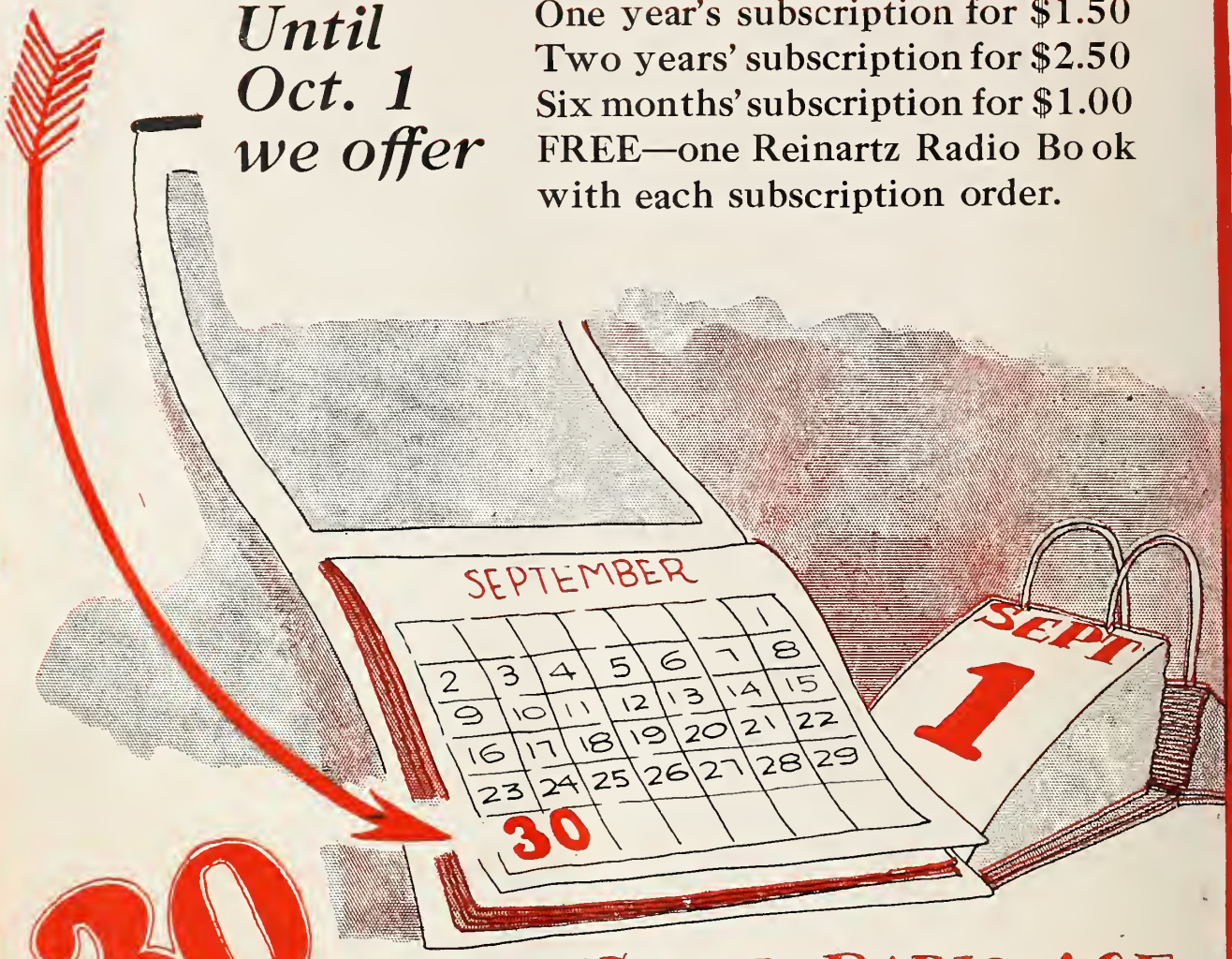

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By Frank D. Pearne

How to Make Your First Tube Set
By Felix Anderson

Meet the Marvelous Trio, Grid, Filament and Plate
By H. M. Freeman

Complete Corrected List of Broadcasting Stations

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RADIO AGE

The Magazine of the Hour

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Solid Radio

ONE of our subscribers writes a letter telling us that he has constructed and successfully operated the latest four circuits which were featured in this magazine. The larger our circle of readers grows the more impressed we become with the eagerness of fans to experiment with new hook-ups.

If a receiver is constructed the fan immediately looks about for additional amplification or for a different antenna arrangement. It is the spirit that kept the amateurs at work long before there were broadcasting stations and it is the spirit which keeps Americans in the front rank in radio development.

All this justifies our original belief that there was a place for a radio periodical which would devote itself to practical radio construction and operation and let the other fellow discuss the wireless possibilities on the planet Mars.

We might publish articles of a general scientific nature, attractively illustrated, but we would then be getting away from radio. We might print pages of pretty actresses with ear-phones (often without connection with a receiver) but we believe the movie and drama journals do that acceptably. Anyhow, what does the fan care about pretty faces when he is hunting hook-ups?

We are printing thirty-two pages of solid radio information, with radio illustrations that have attracted favorable notice from fans as far away as Berlin and Tokio. Yes, we have subscribers in both places.

Let our hook-ups be your guide. You will have plenty of company.

—The Editor.

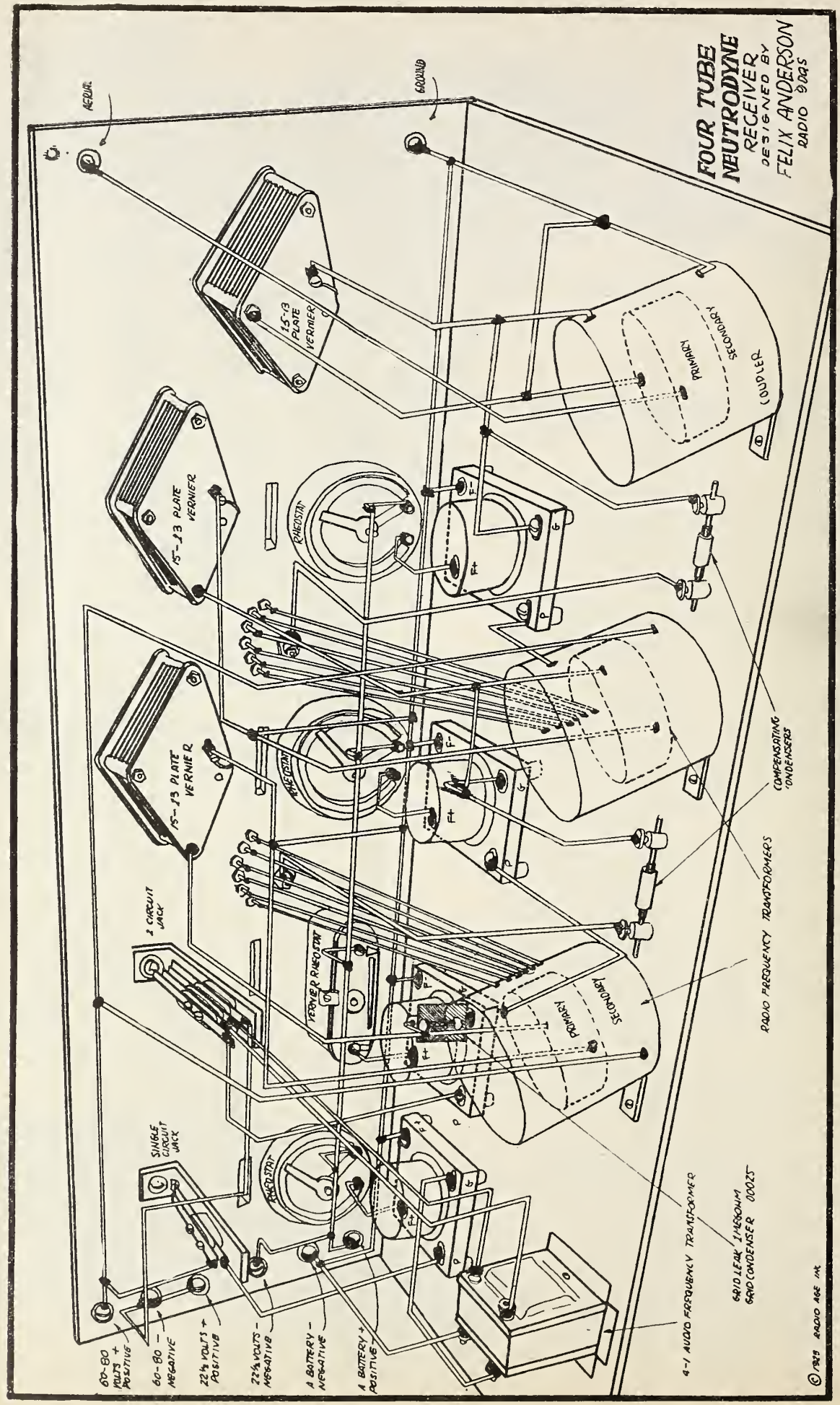


Figure 1. Isometric drawing showing the layout, wiring and construction of the Hazeltine Four Tube Neutrodyne Circuit.

RADIO AGE
"The Magazine of the Hour"
M. B. SMITH, PUBLISHER
PUBLISHED MONTHLY
FREDERICK SMITH, EDITOR

Construction of the Four Tube Neutrodyne-

By Frank D. Pearne

ONE of the most popular sets today is the Neutrodyne, first introduced by Professor L. A. Hazeltine, of the Stevens Institute of Technology, Hoboken, N. J. Since his disclosure of the idea before a meeting of the Radio Club of America, last March, many circuits have sprung up, which employ the original idea explained by Professor Hazeltine.

Briefly, this arrangement consists of methods of overcoming by neutralization, the various capacities between the component parts of the receiver and amplifier circuits and for distance, reception and clarity it ranks with the best. The great simplicity of control, combined with the fact that much may be done with very few tubes, compared to other circuits, makes it an extremely interesting circuit.

In the early days of the Neutrodyne, the circuit was made practical only by the use of a potentiometer, by means of which a slight positive potential was impressed upon the grids. Regeneration through coupling between the grid and plate, is the factor which causes the tubes to oscillate. If the capacity of the tubes is neutralized, the oscillations are stopped and the circuit is stabilized over a wide range of frequencies (depending upon the design of the transformers) without using a potentiometer.

In the design of the set explained in this article, the receiving range has been set at from 200 to 600 meters, and the transformers described will give splendid results over this wave band. Three transformers are to be made, one being merely a tuning coupler, while the other two are used as radio frequency transformers. For their construction it will first be necessary to procure three bakelite, or pasteboard tubes three inches long and three and one-half inches in diameter; also three tubes of the same material, three inches long and three and one-fourth inches in diameter. The two three and one-fourth used in the radio frequency transformers are wound with six turns of No. 28 D. C. C. copper wire, beginning at a point one-half inch from one end and spacing the turns so that the winding will cover a space of one-half inch. On the third three and one-fourth inch tube, wind a coil of ten turns of the same size of wire and spacing them the same distance apart as those in the six turn coils.

This completes the primary windings of the two radio frequency transformers and the primary of the tuning coupler. The secondaries are next wound, the three and one-half inch tubes being used for this purpose. Wind each of these tubes with sixty-five turns of No. 24 D. C. C. wire, beginning one-half inch from the end of the tube. On the two which are to be used as radio frequency transformers, tap the coils at the 12th, 13th, 14th, 15th, 16th, and 17th, turns. All six of these windings on the tubes must be wound in the same direction.

The two six-turn coils, which are to be used as the primaries of the radio frequency transformers, are placed inside of the two coils with the tapped windings. These are so placed that the inside and outside windings are in the same direction and start from the same end. The other two coils, one with ten turns and the other with sixty-five turns are also assembled in the same way and form the tuning coupler which is shown at the right, in Figure 1.

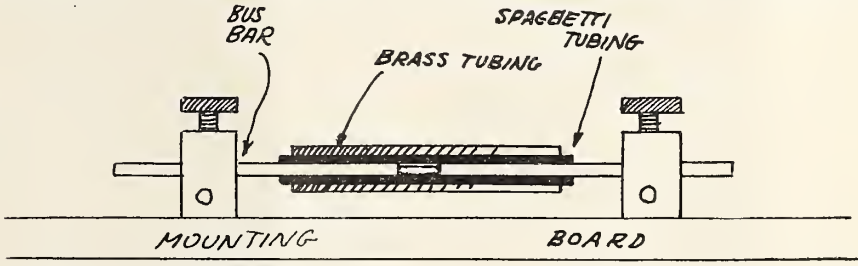


Figure 2. The two wires, in conjunction with the brass tubing and spaghetti covering insulation form the neutrodyne or compensating condensers. By varying the distance between the wires and changing the position of the brass covering, very delicate changes in capacity can be realized.

In order to prevent inductive coupling between them, they must be mounted on an angle of sixty degrees, as shown in Figure 1. This is accomplished by cutting out three brass strips one and one-half inches long, one-half inch wide and one-sixteenth of an inch thick, and bent one-half of an inch from one end, to an angle of sixty degrees, also shown in Figure 1. A hole is drilled in each of these brackets, so formed, to allow for fastening to the baseboard and to the transformers. By drilling holes through the blank space left at the bottom of the tubes and inserting a small brass machine screw through the bracket and tubes, a very substantial mounting is made. When the panel is laid out, one condenser must be placed as close to the left hand end of the panel

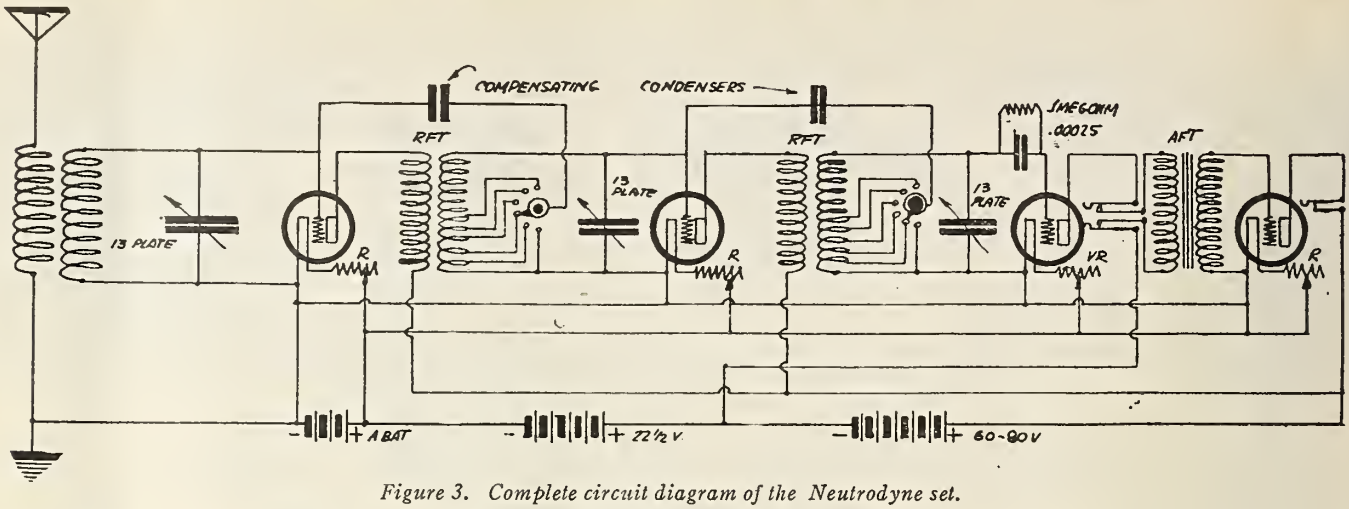


Figure 3. Complete circuit diagram of the Neutrodyne set.

as possible (looking at panel from front) and in the center as shown.

The next condenser is placed six and one-half inches from this one, and the third is mounted the same distance from the second. While the rheostats are shown as mounted below the condensers, they may be placed above them if desired; however, it will be better to follow the general idea of the layout shown in Figure 1, if possible. This shows quite clearly the method of mounting the different parts. In wiring the set, great care should be used to avoid running wires in parallel, unless they are some distance apart. The small neutralizing condensers are made as shown in Figure 2.

While these are shown as mounted directly upon the base board, it is a much better idea to mount them separately on bases made of sheet bakelite, which are in turn mounted on the main base board. Two binding posts are used as the supports for the No. 14 copper wires which are placed inside the brass tube.

These two wires are insulated from the brass tube by a piece of spaghetti tubing. The length of the brass tube is one and one-half inches, and the outside diameter is one-fourth inch. When the adjusting begins, this tube may be slipped back and forth, thus changing the capacity until the proper point is found, where neutralizing is as near as possible. The two wires do not touch each other; they should be so arranged that the distance between them can be altered.

After the set is all wired up and all connections soldered, plug in the phones and light the tubes. Turn the first dial to about twenty-five, and rotate the other two dials together. When a wave has been tuned in to the loudest degree, on all three dials and rheostats, the first radio frequency tube (the one nearest the coupler) is taken out of its socket and a piece of paper is placed over one of the filament contacts, so that when the tube is replaced, the filament circuit will be open at this point.

While doing this, be careful not to change any of the dial or rheostat adjustments. Now if the station can still be heard, change the capacity of the first neutralizing, or compensating condenser, by moving the brass tube, until the signal disappears. If it can still be heard regardless of the position of the brass tube, turn the switch which controls the taps on the first radio frequency transformer to another point and move the brass tube again. Continue this operation until the signal disappears. Next remove the paper, replace the tube and do the same thing with the second radio frequency tube until no signal is heard.

The neutralizing condensers are then in adjustment for the particular tube used and may be sealed permanently until the tube burns out, or is replaced for other reasons. The paper is then removed and the set is ready for operation. Looking at the front of the panel, the two tubes on the left hand side are the radio frequency tubes, the next is a detector tube and the fourth is the audio frequency amplifier tube. By adjusting the neutralizing condensers as explained above, the capacity of the plate, grid elements of the tubes will be neutralized.

The switches shown on the panel in Figure 1 are the ordinary switches and contact points usually used for the taps on a variocoupler and can be obtained with the other apparatus at any radio supply store. The audio frequency transformer may be any of the standard makes, but must have a four to one ratio. One very good point in favor of this set is the fact that when a certain wave is adjusted in, the dials may be marked at this point and the same wave length can always be found at any time by simply moving them back to these points. Thus the matter of adjustment becomes very simple, after it has once been located. This makes it possible for anyone to find a station without having any knowledge of how to adjust a set. Figure 3 is the complete circuit diagram of the Neutrodyne set.

Fight News via Air

News of the result of the Dempsey-Firpo fight in New York was transmitted across the country by radio in a manner that again demonstrated the value of wireless as a means of communication to the millions.

Broadcasting stations all over the country got the word of the finish within a few minutes of the last blow delivered by Dempsey. Entertainment programs were interrupted to permit the broadcasting of a fight bulletin. Details were added later and from most of the stations a detailed account of the brief combat was put on the air.

WGY, the General Electric Company's broadcasting station at Schenectady had a direct wire to the scene of the fight and got its report from a newspaper boxing authority.

In Grand Canyon

The geological survey party carrying a radio set on a trip through the Grand Canyon of the Colorado, has arrived safely at Bright Angel trail. Notwithstanding the predictions of experts that it would be impossible to receive radio messages while in the bottom of Grand Canyon, Colonel Birdseye reports that he is in daily receipt of messages broadcasted from Los Angeles, Salt Lake and Chicago. He received the news of President Harding's death within forty-five minutes after it occurred. Reports of his progress will be sent out for broadcasting when he reaches Diamond Creek, October 15.

How to Make Your First Tube Set

By FELIX ANDERSON
Technical Assistant Radio Age

WHEN the radio game took its first big leap toward becoming a popular diversion, one of the first ideas the newly inoculated novice had in mind was to get a simple set, get one quickly, and at the same time inexpensively.

The scarcity of tubes and sets, together with the lack of knowledge concerning their operation and the subsequent high prices, due to the scarcity of apparatus, is responsible probably, for the many crystal sets.

We know the impression the term "tube" set conveys, and the average fan knows that feeling of reckless extravagance with $$$ fluttering around in the air when tube sets and their accessories are mentioned. Now that the dry cell tubes and accessories have been placed within the reach of the average novice, there is no reason why an enthusiast should continue using a crystal set with its restricted range and its limited tuning facilities.

We so not want to commence a long-winded article on the comparative merits of tube versus crystal—the answer favoring tubes is self evident; but what we do want to make plain is the fact that the superiority of the tubes, including the ease of tuning, selectivity and their greater range which they furnish, makes it well worth while for the novice to own a vacuum tube outfit.

MANY crystal set users have set up a cry that they are being neglected—that nearly all radio magazines devote too much space to sets using vacuum tubes. We agree with them in certain particulars, explaining the seeming neglect by saying that crystal sets, while efficient, provide little room for development, inasmuch as they have been improved to a point where further experiments give about the same results. Like electrolytic and magnetic rectifiers, its scope of usefulness has crystalized, and considering the comparative merits of crystal and tube detection, we would advise our readers to look over the following article and profit by it.

THE EDITOR.

Many crystal set owners are under the impression that the construction of a valve set requires much skill and a comprehensive knowledge of electricity—both of which are desirable qualities to possess—but on the contrary, the making of a simple efficient set using a bulb is happily not difficult, and fortunately requires only a little patience and care.

We know that many people do not even own sets, and to the uninitiated we wish to say that a great store of pleasure and enjoyment is at their disposal, once the prospective fan decides to build a set.

Of course, he will want to make the first attempt end in a success, and we are partial to the circuit shown in Figure 2, feeling that this is probably the best circuit for the beginner to commence his radio career. Wading into detail, the first thing we will need is the parts which go to make up the set. We will need: 1 variometer; 1 43-plate variable vernier condenser; 1 tube socket; 1 vernier rheostat; 1 panel, 7x9 inches, of bakelite; 8 binding posts; 1 WD 12 vacuum tube; 1 tapped 22 1-2 volt B battery; 1 dry cell battery; 1 pair telephones; connecting wire, aerial, ground and cabinet.

The cost of the above apparatus is entirely dependent upon the character

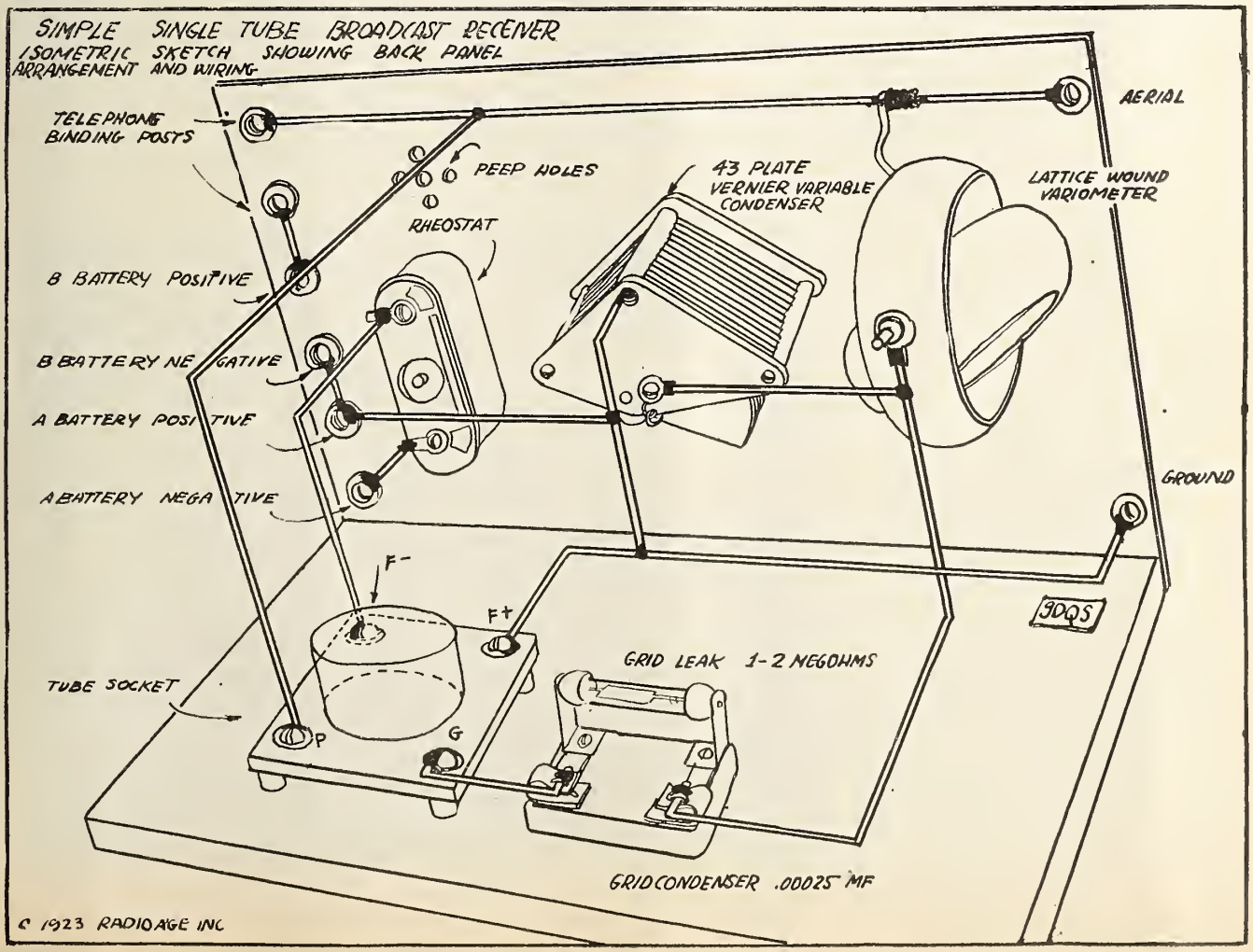


Figure 1.

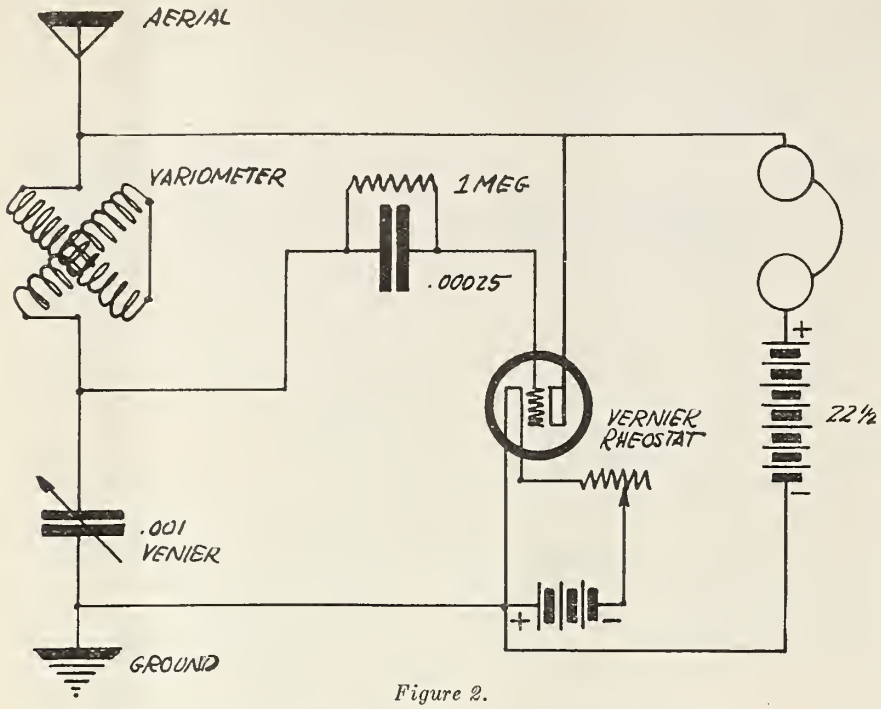


Figure 2.

of the apparatus chosen; but in any event, the set should not cost more than a few hour's time, and about twenty-five dollars in cash. The above list includes everything necessary to the set.

The beginner probably will wonder as to how he is going to put this collection of apparatus together in a radio circuit, and knowing that perhaps few understand the mysteries of the so-called circuit diagram, an isometeric sketch is shown in Figure 1 which eliminates any doubt as to the connection of parts.

The most simple way to assemble the set is to arrange the apparatus as shown in the illustration, and mount the parts on the panel with the respective parts provided for that purpose.

Wire up the set as shown, taking especial pains to make the connections tight and rigid, using solder wherever possible. Soldering should be done with flux—not acids, and should after completion be wiped with alcohol.

The variometer shown is of the lattice-wound type but any other standard variometer may be utilized so long as the connections are made correctly.

It is a good plan to start wiring up the A battery or filament circuit, (the circuit which lights the tube) first, and test the rheostat and tube socket connections to see if they are correct before proceeding further. After this has been done, the remaining wires may be added.

When this has been completed, the set is connected to the antenna.* Next connect the ground and batteries, setting the rheostat at the off position, and last the head phones. Put the B battery positive, or plus wire, on the positive (plus) 22 1-2 volt tap on the plate battery and then turn on the filament about a little less than half. Listening in on the headset, turn the condenser and vary the variometer until a station carrier wave announces itself by a sharp squeal or whistle, and proceed to clear up the signal by closer tuning and finally the vernier on the rheostat. If a Bradleystat is used as shown, fine tuning may be accomplished, due to the delicate adjustments possible.

When adjusting the set for long distance reception, try tuning the set with the B positive wire on various taps until the proper adjustment is obtained. Usually if the set is hard to tune and difficulty is experienced in bringing in the distant station, a decrease in the plate voltage will clear this up. We find that about the best results are obtained when 16 to 18 volts are used on the plate. The set when properly adjusted should give a soft thump or hiss when the condenser or variometer are varied.

The set tunes moderately close, the writer having tuned in stations right through local stations going full blast. The range of the set is necessarily limited by the location in which it is operated. Relative to the above it might be in order to mention that a set of this type operated at Chicago at a point seven miles from the powerful stations WMAQ and KYW, in one evening tuned in stations WSB, WSAH, WSAI (very loudly) and WOC, in less than an hour's time. These stations were heard distinctly, with little fading right through the local transmitting. This set is truly a BCL (Broadcast Listening) set.

Now for the fellows who already have crystals. We know that many readers would like to convert their present crystal sets into sets using tubes. In order that they may really get a kick out of the game, and do some real listening, we are printing a series of circuits showing how the conventional crystal sets may be rebuilt with the addition of a few pieces of inexpensive apparatus, to make an efficient tube unit capable of receivng over much greater distances and effecting greater selectivity.

If you possess a single side tuning coil crystal set, remove the crystal detector, substitute a tube and 43-plate condenser in the circuit as in Figure 3. The principle of this circuit is much the same as that of the circuit preceding with the exception that the variometer is substituted by a tuning coil.

The tube arrangement for a two slide is a little different. One of the sliders is connected to the antenna while the other connects to the grid leak and condenser as demonstrated in Figure 4. One of our St. Louis readers is using this circuit with great success.

The long distance crystal set which seems about the most efficient crystal set does not escape being a subject for a tube set. The bulb and a 23-plate vernier, in connection with a 25-turn

(*Continued on page 32.*)

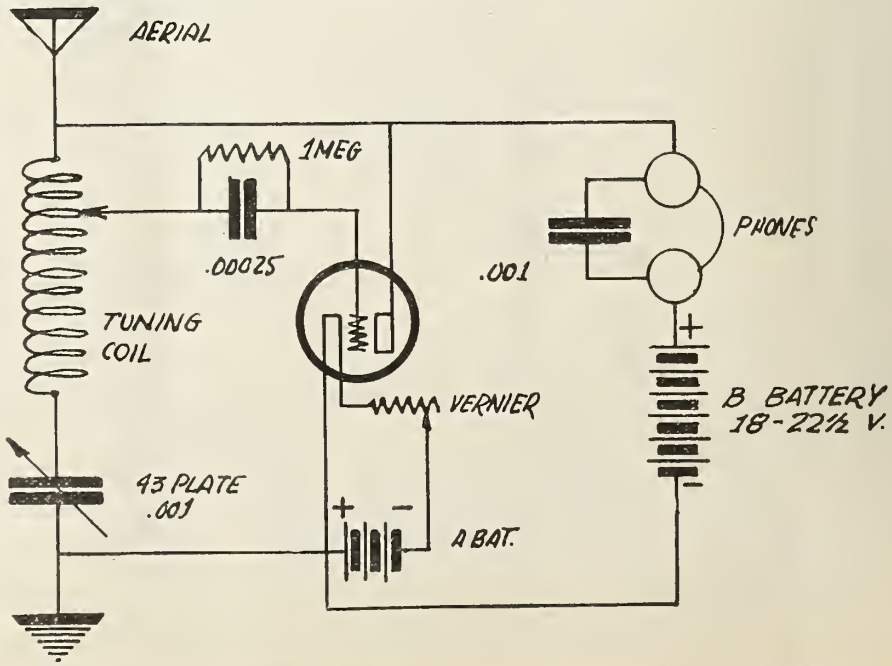


Figure 3—Circuit diagram showing how the apparatus used in a single-slide crystal receiver may be used in a tube set.

What Will Your Set Look Like Five Years From Now?

WE WONDER if there are any old-timers among our readers who remember way back when the set shown in Figure 1 was in vogue? Do you remember when tube sets were a thing of the future and Neutrodyne and Cockaday circuits were a thing unheard of?

The photograph shown in Figure 1 is a picture of the first transmitter at 9DQS, taken several years ago. The single slide tuning coil and crystal detector will probably raise a laugh from some of our interested readers who are the proud owners of six-tube sets which can apprehend signals from almost any part of the country, but the writer remembers the times when he heard signals from a very distant amateur some thirty miles away, and was as elated and as proud as a radio bug could be. The transmitter, consisting of a one-half inch spark coil, was the subject of much awe when interested friends were told that a communication had been carried on over the tremendous distance of ten miles! We remember the time when people hearing their first radio signals assumed the look of dummies and said: "Is it possible that you can really hear those things from the air with this apparatus?" and evinced their meager knowledge of radio by saying, "I wouldn't be able to understand a single thing about it."

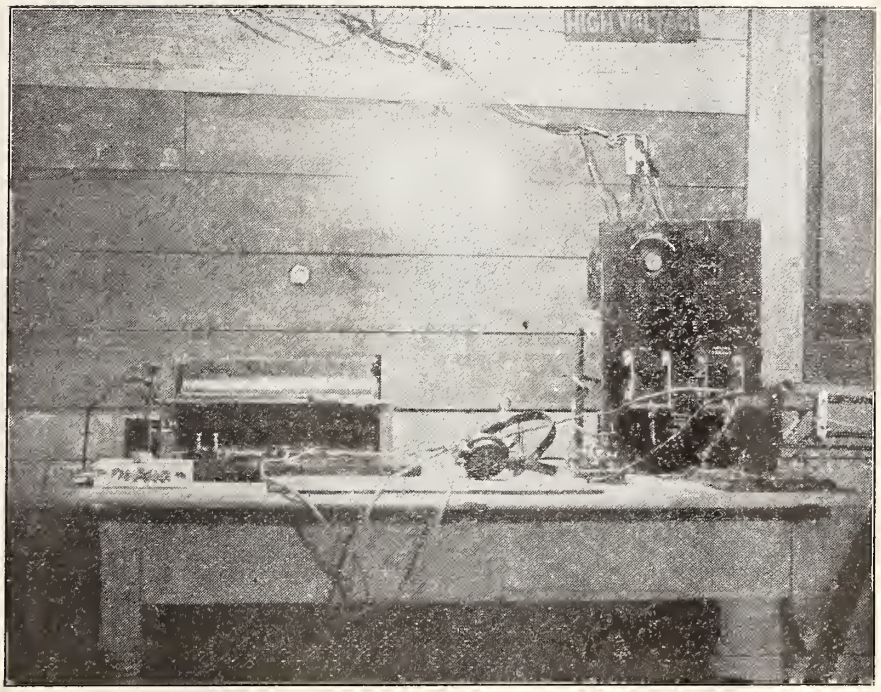


Figure 1. This is the first receiver and transmitter used at Radio Station 9DQS, showing the typical receiver and transmitter used by radio nuts several years ago.

Nevertheless, the photo shown is only a typical station of the many that were in use right after the war.

As a result of the big fight, radio got its first real start, and resulted in the popular use of tubes. We remember the time when the fellow with a tube set could look with scorn upon the crystal user (he probably still does) and pass the remark, "Why don't you get yourself a real set?" Tubes in those days were worth their weight in gold and it provokes our humor when we recollect how honored we felt when we were allowed to hold in our hands a real radio tube.

Of course, as soon as these valves were placed on the market at a price which did not necessitate your mortgaging the house, radio 9DQS became the owner of one of them. The first tube set used at the above station at that time was a whizz. It would oscillate to beat the band on about 3,000 meters, and the writer was much satisfied when he heard NAA at Arlington for the first time so loud that you could hear it almost six inches from the headset. As a short-wave tuner it was a complete failure—we never stopped to reason out why, but it refused to percolate. The three-slide tuner was discarded for a more efficient circuit called the honeycomb coil circuit, and the range of the set and satisfaction of the operator went up simultaneously.

(*Continued on page 27.*)

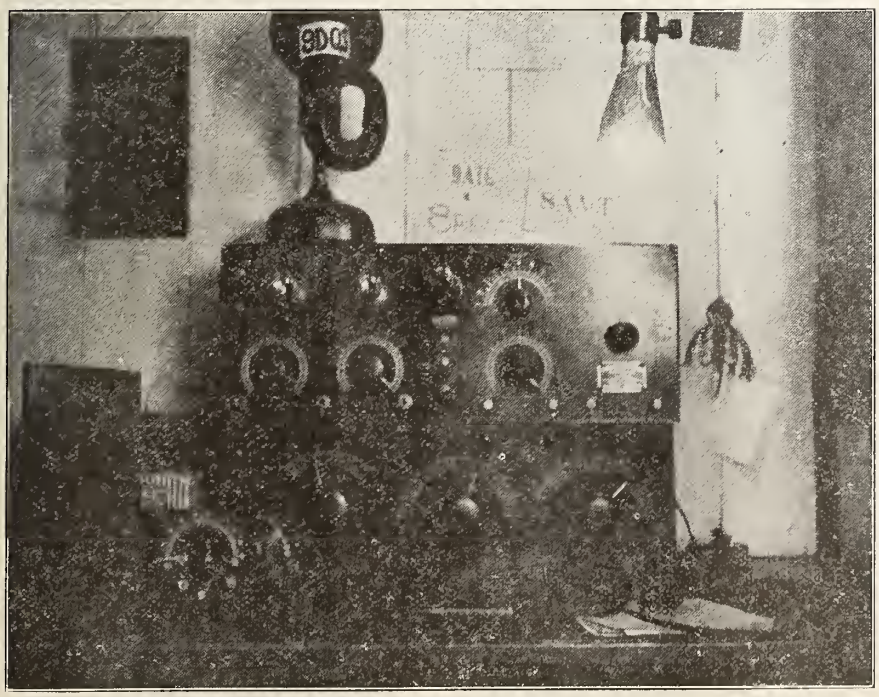
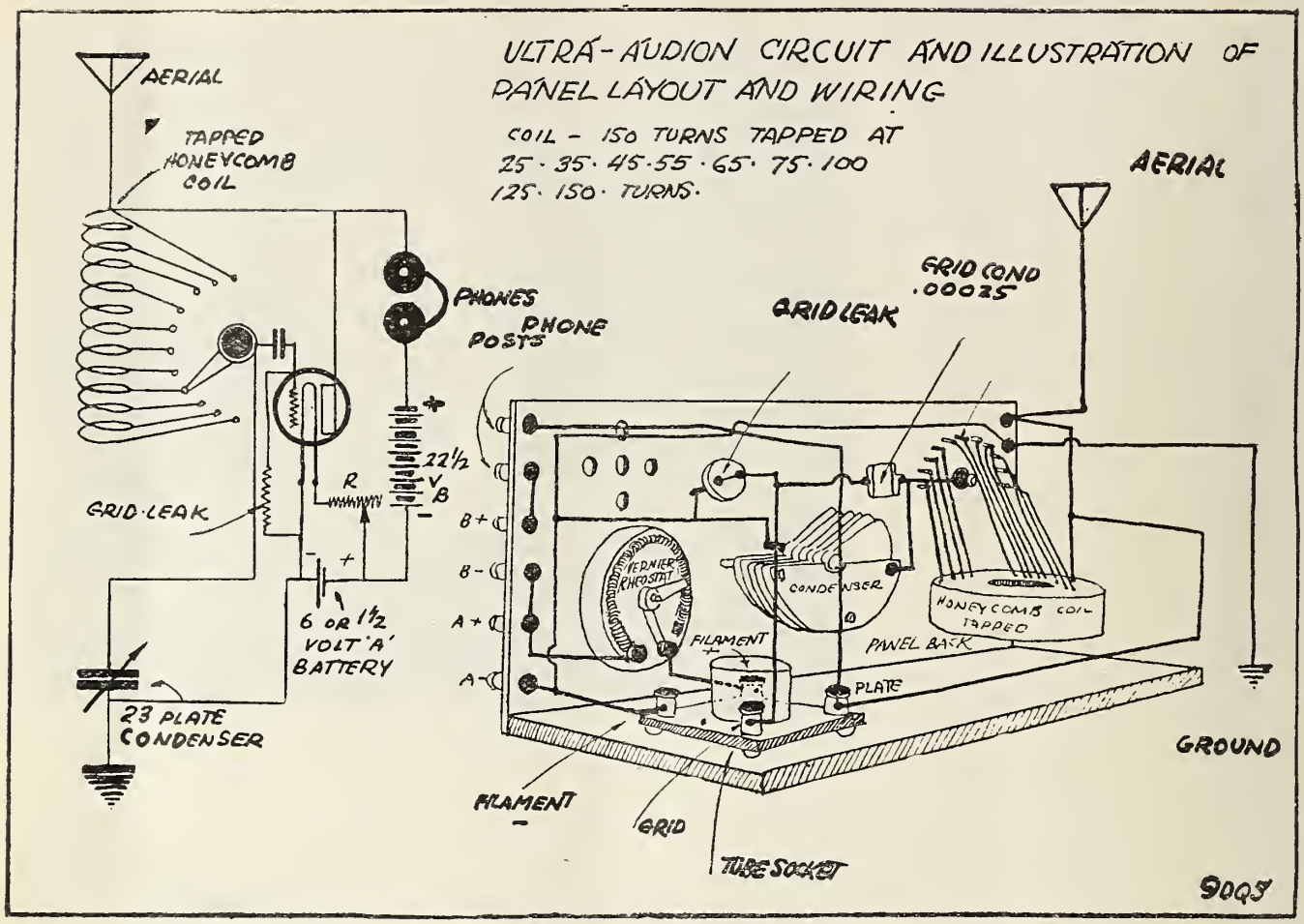


Figure 2. The receiver used last winter at station 9DQS. It is much like the ones now in use, and has to its credit reception from stations some 3,000 miles away.

How to Make an Ultra-Audion Receiver

By the Technical Assistant



ONE OF the oldest and most efficient tube circuits evolved in the course of vacuum tube experimentation is the Ultra Audion circuit, which during the years of its use has not changed appreciably, and which remains one of the most efficient single circuit systems now in use.

A set of this type is simple to construct, requires a minimum of apparatus, and is not difficult to operate.

The layout and circuit, shown in the accompanying illustration, shows plainly the simplicity of such an outfit, and it may be an interesting experiment for our readers to construct one.

The parts required for such a circuit are a honeycomb coil tapped at the intervals specified, a 23-plate condenser, preferably a vernier, a vernier rheostat of the type suitable for the tube used, a grid leak of 1 megohm resistance, and a grid condenser of .00025 microfarads capacity, with the necessary accessories, tube socket, binding posts, panel, mounting board and connecting wire.

A coil as specified is now on the market, and can be secured from your local dealer; if not it may be wound on a fibre or cardboard tubing 3 inches in diameter with the required number of turns using number 22 D C C wire.

Connections are made as shown in the accompanying working drawing, and should be firmly soldered at all points. The set is adaptable to both dry cell and wet battery tubes, and functions equally well with all of them.

It will be noted that the grid leak occupies a different position in the circuit than that of the usual position, and that the B battery is connected to the positive A battery with the negative to the ground.

Tuning, while not as sharp as that of a two-circuit set is accomplished by the 23-plate condenser, the taps on the coil, and the vernier on the rheostat.

One of our readers, using this circuit has heard stations 1,000 miles distant, using one tube, under conditions far from favorable; and this feat may be duplicated almost at any time if the set is carefully and intelligently constructed.

Story Writing

Believing that a great proportion of the public either write or think that they can write as well as some of the stories they see in the current magazines, Westinghouse Radio Station WBZ, at Springfield, Massachusetts, has arranged with Dr. J. Berg Esenwein, a short story critic, to give a course of short story writing in ten lectures by the radio. The course will cover the elements of writing, with lectures on plot interest, climaxes, etc.

At the end of the course each of the persons taking the course will be allowed to submit a short story and the best story will be awarded a prize of $25. Second and third prizes of $15 and $10 will be given the next best stories.

In his course, Dr. Esenwein will outline the specifications for the contest and entrants will have to listen closely to each talk, as the stories will naturally be written so as to follow the rules laid down. In fact, the best story will be judged first from the point of view of correct story writing.

The course commenced on Thursday, September 13, at 7:40 p. m., and the succeeding nine lectures will be given on Thursday of each week at the same time.

Wyoming Indians, enroute to England, camped in New York City and were entertained by a radio concert. Left to right, Red Turtle, Mrs. Red Turtle, Sitting Eagle, White Bull and Red Fox. The brave at the extreme right is not identified. Kadel & Herbert Photo.

Meet the Marvelous Trio, Grid, Filament and Plate

Written by H. M. Freeman, Research Engineer of the Westinghouse Electric & Manufacturing Company

MOST radio amateurs know what a vacuum tube looks like. Most of them have already passed through the preliminary stages where anything that would receive the local station was good enough, and are taking advantage of the tremendously increased range of the tube set. Others are still satisfied with the cheap and convenient crystal set, and are content to hear only the local stations. It is the large and growing class of those who are just beginning to ask: "How can I get these distant stations that my friends are talking about?" for whom this article is written.

In the first place, what can we do with a tube set that makes it so much more desirable than a crystal set? A simple crystal set furnishes perhaps the least complicated way of receiving local broadcast material. You can receive good clear music and speech within a radius of twenty-five or thirty miles from one of the large broadcasting stations. Under exceptional conditions it may be possible to get dependable results over distances somewhat greater than this. There are no replacements of wornout parts to make, and with reasonable care a set is always ready to pick up a concert with a minimum of preliminary adjustment.

By way of comparison, let us look at the ordinary tube set. We find that we have batteries to buy occasionally as old ones wear out; the tube itself is a fragile piece of apparatus and liable to breakage, and altogether there is a rather more complicated set of adjustments to make for reception than is the case with the crystal set. Wherein then lies the advantage? A tube set with a single tube, will increase the reliable listening range three or four-fold over the crystal set. In other words, you can live 100 to 150 miles from one of the big broadcasting stations and be perfectly sure of receiving their concerts and speeches at any time. In addition, with reasonably good conditions it will be possible to hear stations hundreds of miles away and to participate in the fascinating sport of "listening in" with the possibility of hearing concerts or lectures or news from a dozen widely separated sections of the country. I shall try to describe very briefly the properties of the vacuum tube that makes it possible to obtain such wonderful results in receiving.

YOU fellows who are well along in the radio art and who know that electrons are not eaten off a plate and that the grid has nothing to do with a football—we are not talking to you.

But for those among our readers who have not understood the almost miraculous accomplishments of these three elements of the vacuum tube called WD-11 we recommen a careful reading of this article.

The tube is only one of the various developments which have brought the wonders of wireless transmission within the reach of appreciative millions. Mr. Freeman has written a clear description without flourish of rhetoric but between the lines it is a fairy story in every respect—except that it is all true.

Much has been written about the mechanism by which the sound at the broadcasting station is converted into electrical energy and is sent out from the transmitting antenna in all directions in the form of ether waves. A receiving antenna lies in the path of these waves and therefore picks up a very minute fraction of the electrical energy sent out from the transmitting station. This energy exists in the form of an extremely small electric current in the receiving antenna and must be converted back into a form suitable for making the audible signal which is heard in the telephone receivers. It is the function of the receiving tube to perform this conversion process which is necessary before the energy collected from the transmitting station can be perceived by the ear.

(Continued on page 30.)

Amateurs Meet in Chicago

THE participation of French radio amateurs in the proposed trans-atlantic tests of the American Radio Relay League with European radio men in December of this year was assured by Monsieur Leon Deloy, operator of French station 8AB, at the Second National A. R. R. L. Convention held by the Chicago Radio Traffic Association, Sepetember 11 to 15.

Since he arrived for the purpose of studying amateur conditions, Monsieur Deloy has been conferring with delegates attending the convention on the precautions which must be taken in order to establish two-way communication between the continents. He says the difficulty lies in copying signals through heavy static and that with mild static low power signals could be more easily logged. Of the great number of amateur stations seen he said: "I have been impressed by the business-like way in which they are installed and operated.

"In France our transmitting stations are very much less numerous for we have been allowed to transmit only a year and a half, but if their number continues to increase as fast as it has of late we will soon have a great many stations. We are not allowed to exchange messages and we can only use our transmitters for experimenting. That is why the average station over there is built somewhat differently than here. In France we are greatly interested in transatlantic communication with the amateurs of this country. A big effort is being made now and many good stations should be ready to bridge the Atlantic very soon."

A world amateur radio relay league through which better understanding may be reached among the people of all countries by direct communication among private citizens using long distance code transmitters was prophesied at the opening banquet of the convention in a message from Hiram Percy Maxim, president of the American Radio Relay League, and by Irving Herriott, president of the Chicago Radio Traffic Association.

Natural obstacles to private communication between countries have been swept away through the advance of DX transmission and amateur radio is on the verge of a new era where international message handling will be an every day event, according to Mr. Maxim, who sent his greeting to the assembled delegates from a little cabin in the Maine woods where he is spending his vacation. The message was read to about 1,000 amateurs by R. H. G. Mathews, A. R. R. L. Central Division Manager.

"We have already been asked to help out the Australians, English and other amateurs," he stated, "and it is my belief that the time has come for the calling of an international convention and the organization of a world amateur radio league. I urge that you give it your thought so that we may have the benefit of the general study for consideration."

Irving Herriott, chief of the Chicago Radio Traffic Association, who was active in welcoming and entertaining delegates to the A. R. R. L. convention in Chicago.

The contact by radio between persons of two countries is bound to result in a better understanding between the peoples of those countries, Mr. Herriott assured the convention. The advent of broadcasting has done much already to knit together our own people and places which have been mere names are now brought home to us by radio.

Friendships made through the ether over many thousands of miles by men of amateur radio telegraph transmitting stations was responsible for the presence of a huge throng of radio men numbering upwards of 1,500, many of whom were scurrying about in search of pals whom they know only by conversation in the air.

The spectacle of hundreds of men seeking out other friends whom they can recognize only by station calls attached to their coat labels, is unprecedented except at a radio convention. All faces wore a searching look as amateurs peered here and there for a pal from New Orleans, Newark, Boston, Seattle or Kansas City, for there are few cities that were not represented by a delegation.

Some met on trains coming into the city, others on station platforms, while the Edgewater Beach Hotel, convention headquarters, is a scene of merriment which only a hamfest can cause. Cries of Hello 1XAD, 2AJ, 6KA or 7AB, representing all radio districts, brought looks of astonishment from outsiders bewildered by the queer mixture of numbers and letters, not knowing that to the key pounder mere names are secondary to the station calls.

One matter discussed by the division managers was the formation of an organized system to handle railroad communications in times of emergency. A study of the situation has been made jointly by the A. R. R. L. and the American Railway Association. The scheme is national in scope and will provide against the cutting off of wire telegraph communication during severe storms.

Methods of providing for prompt delivery of friendly messages, a new system of amateur abbreviations, quiet hours and amateur wave length were among routine league topics.

Radio Birds

Even the birds in Washington are radio fans, and their insistence upon attending broadcasting events is causing some of the local stations considerable embarrassment.

Engineers of the Chesapeake and Potomac Telephone Company, broadcasting station, WCAP, found themselves in difficulties during the broadcasting of the dinner given to Paul Whiteman in New York, received here by land wire from WEAF, because of the antics of a flock of swallows which had settled upon the station's antenna.

Shortly after the program began, the wave length of the station suddenly increased from 469 to 479 meters, the vacuum tubes in the transmitter began to heat up and the plate current increased tremendously. In order to save the tubes, it was necessary to reduce the plate voltage from 1,600 to 1,450 volts, but even after this reduction was made the plate current was 850 milliamperes instead of the normal 700 milliamperes.

Emergency apparatus was placed in readiness for immediate use, as the engineers scurried around seeking the cause of the trouble. One of the men went out to look the antenna over, and almost fainted to see a flock of swallows calmly roosted on the wires. The lead-in wire was shaken sufficiently to cause the unwelcome radio fans to seek some other resting place for the night, and conditions in the operating room returned to normal.

The experience is believed to be new in the history of radio broadcasting. Engineers of Station WCAP explain that the size of the antenna was increased by the size of the birds' bodies, thus increasing the wave length and causing a greater current to flow. They deny, however, that the birds were attracted to the antenna for a feast of mythical "wire worms" or that they are in the market for a radio scarecrow.

Here's a Secret

Fans who have listened to KYW, Chicago, have marvelled at the excellent voice of Simon H. Rhoades, singer of Irish ballads. They will not be surprised to learn that John McCormack called Rhoades one of the greatest singers of Irish ballads. But they probably haven't suspected that Mr. Rhoades is a Negro. Listen in some night and hear him sing, "Where the River Shannon Flows."

Radio Sends News from Arctics

THE latest word from the Dr. Donald B. McMillan Arctic Expedition before going to press with this October issue of RADIO AGE was received by J. Barnsley, station Canadian 9BP at Prince Rupert, British Columbia.

Mr. Barnsley copied two messages, each containing about five hundred words. These dispatches show that the "Bowdoin," the little ship in which the McMillan party ventured into the far north, is in winter quarters in Flagler Bay, near the 80th parallel, between Elsemereland and Greenland.

The water is freezing rapidly, according to the messages and there is a foot of snow on the ground.

A significant bit of information contained in the messages ticked off by Donald Mix, the operator on the "Bowdoin," is the fact that the crew discovered a tablet presented to Dr. McMillan and buried in the provisions in such a manner that the tablet would not be revealed for some time after the ship had reached the far north.

The tablet was given by the Theta Delta Chi fraternity, members of an Eastern school. The significance of the fact that its discovery was reported in the dispatches received and transmitted by Mr. Barnsley is that nobody knew that the tablet was hidden in the provisions except E. F. McDonald, Jr., of the Chicago Radio Laboratory and the Zenith Edgewater Beach Hotel broadcasting station, WJAZ

Mr Barnsley, therefore, proves beyond a doubt that he is receiving messages from the "Bowdoin" when he mentions the tablet. The ship is equipped with sending apparatus in charge of Donald Mix, chosen by the American Radio Relay League for the important assignment The ship also carries a powerful Zenith receiving set.

Captain MacMillan first got his idea of taking radio on his trip northward to the pole at a "duck dinner" given him in Chicago last spring At the dinner Captain McMillan met E. F. McDonald, Jr., who explained the value of a receiving set as a means of getting news, concerts and other matter from the States during the long stretches of Arctic solitude, which is the real hardship of the North, according to the captain.

At first the explorer explained that limited space prevented the installation of a set, but later he agreed that it would be fine for his men. As soon as he was "sold" on the receiving end, Mr. McDonald and a friend began to expound the greater value of a transmitting set, incidentally mentioning the possible distribution of information and stories to the world at home. The captain finally decided he wanted a complete radio outfit, and some declare that the equipment will make him the most popular Arctic explorer, whether he gets to the North Pole or not.

Shortly after the dinner, representatives of Mr. McDonald's firm, visited the Bowdoin, and outfitted her with sending and receiving equipment of the latest design. Through the cooperation of the American Relay League and the North American Newspaper Alliance, the world is now hearing of McMillan's progress, while he and his crew receive the daily broadcasts just as we all receive them here at home.

Though icebound and in darkness through the long winter months of the North Pole, trading posts in the Arctic zone will not be entirely isolated from civilization and life. According to plans made by the Hudson Bay Company, lonely posts will be provided with radio receiving sets so as to secure enter-

(*Continued on page 32.*)

U. S. marine radio experts held their annual maneuvers near Waynesboro, Va., in September. They can place this field set, with its forty-five foot aerial, in position and have it in full operation in less than two minutes. They have equipped trucks, airplanes and tanks with radio. Official Marine corps photo.

LISSEN RAY- I'VE GOT A SCHEME TO SAVE MONEY- BZZZ- PUT A JUMPER WIRE ON THE ELECTRIC METER SO'S IT WONT REGISTER- I'VE GOT ONE IN MY JOINT- ITS KEEN!
HOT ZIGGADY!
GOZZLE! THAT'S A KEEN TRICK- GUESS I'LL TRY IT!
THIS SURE IS A NATTY WAY TO SAVE MONEY- ALL I HAFTA DO IS KEEP THE POWER COMPANY FROM GETTING WISE
WELL F122- OLE' BOY DID YOU TRY THAT METER SHUNTING STUNT I WISED YOU UP TO?
YEH- BUT I GOT NAILED- THE METER RAN BACKWARDS AND THE COMPANY INVESTIGATED BECAUSE - AT THE END OF THE MONTH THEY OWED US $13.67!
ONE MONTH LATER
HILDERSON

This is the way Ray D. O' Nutt solved (?) his lighting problem. Try it on your meter.

Round the World

Washington, D. C.—As a means of international communication, radio is spreading its invisible circuits throughout the world with increasing rapidity. During the past month plans for ten gigantic stations in as many countries have been reported to the communication experts of the Department of Commerce.

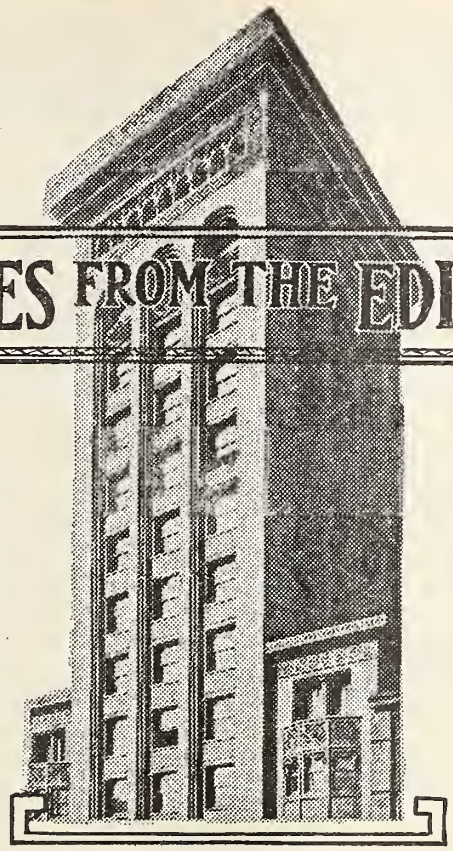
In Europe practically every country is negotiating for large commercial stations. A transmitting plant at Warsaw, Poland, will be opened for business within a few weeks; Italy has a new station at Coltano; Goetberg, Sweden, started up recently; while in Holland, a station at Kootwijk went on the air a short time ago, transmitting especially to the Netherlands Indies.

The French Wireless Company is building a 100 Kilowatt station, estimated to cost over $400,000, near Belgrade, Jugo-Slavia, for the government. This first big Balkan station will insure the immediate dissemination of news and information to the world. Russia has granted this French company a five year contract for the construction of several wireless stations.

The British government has adopted a new radio policy, it is understood, which will permit private or commercial radio concerns to erect and operate high-powered stations in the United Kingdom and the Colonies. The government post officials, however, will not relinquish any part of the existing radio chain, but in addition will probably continue with the plans for a high-powered station at Rugby, England. The Marconi Company and the Eastern Telegraph Company have applied for licenses, the former having an agreement with the Union of South Africa and Canada for the establishment of stations capable of communicating directly with England. The Eastern Company hopes to link India with England by radio.

Difficulties in good radio transmission in Japan are expected to be overcome and bigger and better radio communication established as soon as rehabilitation is well underway. Recent advices from Nippon indicate that a land line from Tokyo to Iwaki has been strung, making through communication to the stricken city possible with the outside world for official and emergency traffic. Radio codes are prohibited temporarily for commercial messages in an effort to save errors and repetition.

China is perhaps the most backward of the Far Eastern nations to accept radio, but due to political handicaps there this country is relying on cable communication; there is, however, the United States Naval Radio station at Peking, which has a circuit with Cavite, direct.



THOUGHT WAVES FROM THE EDITORIAL TOWER

ADD the name of Taki Yonemura to your list of radio heroes. When you were reading those first thrilling accounts of the disaster that wiped out great sections of Tokio and Yokohama on September 1, you were reading the words that Yonemura was sending from the Japanese government wireless station in the little fishing village of Tomioka, 144 miles from Yokohama.

Yonemura was the only man in the station who knew anything of English. He knew it imperfectly. He had practically no knowledge of the continental wireless code.

Cables were broken and useless. Telegraph lines were down and the scene of the tragedy was utterly cut off. Ships in the historic harbor of Yeddo were battling a tidal wave. At any rate their radio equipment was not equal to the transmission of any adequate account of the terrible loss of life and property. If the world were to know about the earthquake, fire and tidal wave Taki Yonemura must tell the story. Taki told it.

For days he stuck by his station, translating Japanese into the difficult code, working his key when earth shocks threatened to trap him in the ruins of his station.

Taki transmitted about five thousand words before communication was established with other points in Japan. His was the first intelligence of one of the greatest disasters in history and his was the continued news service, hour after hour, that carried the story of the cataclysm around the world. Day after day he stood by, struggling with an unfamiliar language, answering every call that came 4,700 miles across the Pacific. When the earthquakes shattered his instruments he repaired them and came on the air again with characteristic Japanese apologies.

On this side of the Pacific his messages were picked up by Radio Corporation stations and transmitted to newspapers and press associations.

Taki Yonemura's construction of sentences was almost ludicrously involved. He wrote dispatches that reminded receiving operators of the famous "Letters of a Japanese Schoolboy," and when a particularly difficult passage in English confronted him he reverted to Japanese. At the end of each message he said, "Please, not no more this time."

The writer has lived in Tokio and Yokohama and he recognizes Taki as a type of the polite Japanese who may belong to the "Yes, we have no bananas" school of letters but he means to be courteous, even though he backs into somebody when making his bow. If you complain to a Japanese waiter that the soup is cold he will smile brightly and exclaim "I am very sorry for you."

Seriously, Taki Yonemura has proved several things to the world. He has again demonstrated the fact that radio has a utility that no longer can escape the thoughtful attention of the public. He has proved again that cables and wires can be dispensed with in emergency and that a new means of communication has been brought to a busy world. Any advance in methods of communcation means a step toward better civilization. Lastly, Taki Yonemura has proved again that the Japanese has steadfast courage.

The same radio that brought the news from Tomioka helped to broadcast appeals for the relief fund that will go to relieve the suffering in the Island empire. Yonemura's work hastened the organization of this world-wide act of human kindness and was therefore of untold benefit to his countrymen. The Japanese keenly appreciate heroism. Here's hoping the lone keypounder in the little fishing village will not be overlooked when the empire awards its laurel wreaths for noble action done in the hour of horrid tragedy.

As for America, Taki, our hats are off to you.

His Last Sermon

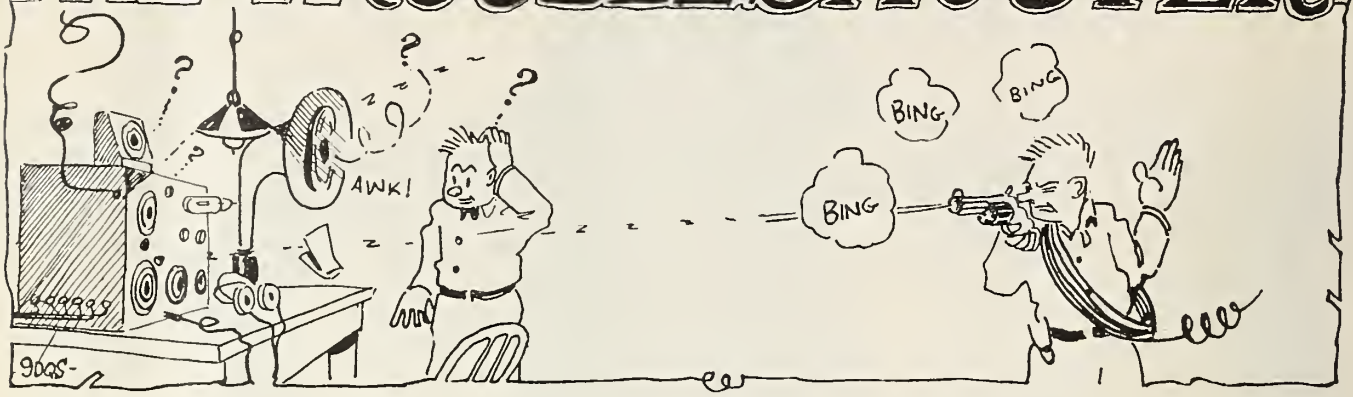
An aged resident of Trumansburg, N. Y., on his deathbed, listened in with members of his family to a radio sermon delivered by the Rev. G. A. Bierdemann, pastor of the Trinity Evangelical Lutheran Church, of Albany, N. Y. The sermon was broadcast from WGY, the Schenectady station of the General Electric Company. Thomas J. Carman, in writing WGY of the reception of the sermon by his father-in-law, stated:

"My father-in-law, who is past ninety, is on his deathbed, and although he can live but a few days, he still has all his faculties. He has always been a sincere Christian. Yesterday morning I asked him if he cared to hear a sermon. He said he did, so we moved our receiving set to his bedside and we all listened to the Rev. G. A. Bierdemann's sermon through your station. After the service father said he heard every word. His wife and I also listened in. Had Dr. Bierdemann prepared his sermon especially for us he could not have made it more comforting."

Radio's Useful Voice

Chicago is using radio in bringing to the people the lesson that the motorist must not speed and must not drive carelessly. With almost five hundred fatal accident thus far this year, Chicago is making a determined effort to bring about a traffic reform. The mayor's safety commission has enlisted the broadcasting stations in the work of carrying warnings to the public and the same educational campaign is being conducted on movie screens and in newspapers.

THE TROUBLESHOOTER



The technical department sends out many replies to questions in each day's mail. In order to assure prompet service to our subscribers the direct reply method hereafter must be restricted to those fans who are on our subscription list.

Fans who are not subscribers may obtain this service by enclosing 50 cents with their question and the reply will be mailed at once, accompanied by circuit diagram where illustration is needed.

All inquiries should be accompanied by self-addressed and stamped envelope.

R. B. T., Chicago, Ill.

Question: Will you kindly advise me the best kind of wire, and dimensions to use on an indoor loop antenna? Would it work just as well to arrange wires upright as in a loop? Any information you can give me will be appreciated. The range I would like to cover is about 1,500 miles with an indoor antenna.

Answer: You will require a very sensitive circuit to do this work, and I am showing in Figure 2 an arrangement which will work very nicely if you have a door handy. The number of turns used on this loop will be entirely a matter of experiment. Another method which you may use is to run a No. 18 D C C wire of the common bell wire type around the picture moulding the number of times depending upon the size of the room and the type of set used.

A. E., Chicago, Ill.

Question: I have assembled a two-stage radio, detector and two-stage audio receiving set on which the stations WMAQ and WJAZ come in so terrifically loud that I am compelled to burn the detector tube very dim. Stations KYW, WDAP and WPAD on 360 meters come in very faint with all of the five tubes burning and I can seldom hear stations on waves lower than 360. Can you give any remedy for this?

Answer: The limitations of your set are probably caused by the fact that the radio frequency transformers which you are using were not designed for wavelengths of 360 meters and lower, and therefore do not respond to signals of these lower frequencies. Your transformers are probably designed for use on waves of from 400 to 500 meters. The only thing to do would be to use either tuned radio frequency or to substitute transformers of the correct design for the 360 meter wave.

E. C. Westmount, Montreal, Canada.

Question: I constructed the Hopwood circuit as published in the July issue of RADIO AGE, using a 23-plate condenser in the aerial instead of a 43-plate. I have tuned in to date ten stations all over 500 miles away but have much difficulty with reception because of body capacity. All the parts of the set squeal when I touch them, even the rheostat and headset. What can I do to prevent some or all of the body capacity? If I put a 43-plate condenser in the aerial would it improve reception?

Figure 7

Answer: I am glad to hear that you are getting such good results with the set, and would advise that some of the body capacity may be removed by placing the condenser in the ground lead with the rotary plates to the ground. You might try shielding the panel with tinfoil, and if it is possible, set the variometers back further in the cabinet with extended shafts so that the hands do not come in proximity to the apparatus. Another good experiment is to ground the negative filament. When a set is affected by body capacity, it is a good sign that the set is very sensitive, and that the least change in the capacities and the parts surrounding will change the wave length of the set. The rearranging of the apparatus might help.

C. D. W., Jr., St. Louis, Mo.

Question: Last spring I built a Kopprash set according to the article in the April issue of your magazine, and have had excellent results with it. Even through the summer months of static, I was not bothered appreciably by atmospherics and could get stations as far as WGY with only one stage of audio. I would like to know if any improvements have been made in the Kopprash hookup since the article was published, and if it would be possible to add radio frequency with any degree of satisfaction. If so, please advise whether tuned or untuned radio frequency would be the best to use, what make and ratio transformers would give the best results, and whether the WD11 and 201A valves could be used in connection with the above addition.

Answer: Sorry, but we have no circuits of the addition of an RF stage to the Kopprash circuit as yet, but are glad to inform you that the engineers of the Technical Department are now

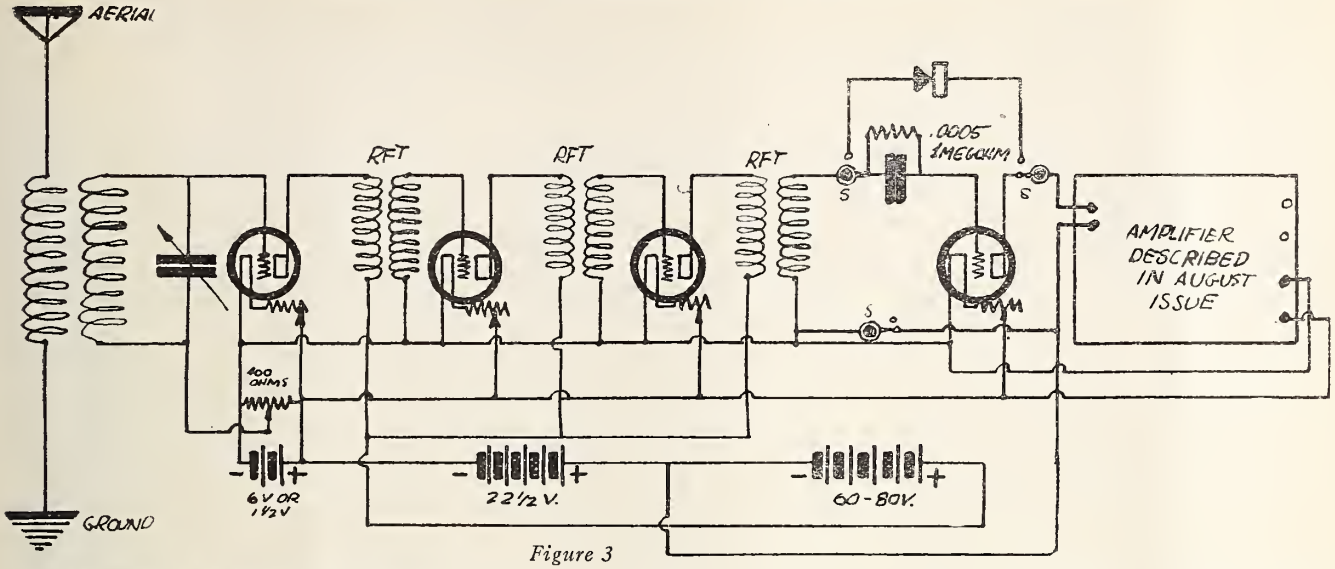


Figure 3

busily engaged in a series of tests with the above circuit in connection with the radio frequency component, and we will as soon as the experiments bear fruit publish a resumé of the best arrangement to use. As soon as the information is ready, I shall promptly send you a copy of the circuit.

J. K., Bridgeport, Conn.

Question: Please print a diagram of a circuit employing three stages of radio frequency and three stages of audio frequency with two variable condensers and a variocoupler as tuners. I would like to have this circuit contain a vacuum tube detector and also a crystal with an arrangement so that either crystal or valve detection may be used. Would the use of one potentiometer on each stage of radio frequency and one on the first stage of audio frequency increase the efficiency of my set?

Answer: I am printing in Figure 3 the circuit you wish. The use of the crystal detector on signals of average audibility will give a clear, undistorted signal, while the tube may be used while doing long distance work. Either arrangement may be used by turning the series-parallel switch bo the proper points. I do not think much will be gained by the use of more than one potentiometer. It should be placed in the first stage of RF and connected across the A battery as indicated on the circuit diagram.

W. E. B., Chicago, Ill.

Question: I am a very recent subscriber, but am taking advantage of your offer to answer questions without loss of time. My aerial consists of two 7 strand copper wires, 57 feet long, about 35 feet high, with a lead in of about 40 feet. Would suggest using three or four wires instead of two? Please advise me. I have just made a Reinartz set with detector and one stage of AF amplification, using UV 199 tubes. I am using two 14-plate vernier variable condensers, and have not been able to get the higher wave lengths. I have room for a 23-plate condenser in the set, and would like to ask if you think this will help if I put it in the place of the 14-plate in the antenna circuit? There is a hum in my sets, (I have used several) which I think comes from a transforming station of the local power company, about four blocks from my home. Is there any suggestion you can make to help this? I am enclosing a sketch of my aerial.

Answer: From your sketch I conclude that your antenna is a good one, and would not advise your adding more wires to the present number, as it will only make it tune broader and make it more susceptible to atmospherics. About the only improvement you could make is to connect the two wires of the antenna together at the end opposite the lead in. This will make the wires tune more sharply. The September issue contains the information necessary for the loading of the Reinartz circuit. I am printing in Figure 1 a trap circuit which is sometimes effective in excluding the interference from the 60 cycle power lines. Would advise that you place your aerial at right angles to the source of interference if possible. This interference might not necessarily be due to the transforming station, but might be due to supply line or transformer leakage in your immediate vicinity. Would advise that you make a careful search to ascertain whether your aerial does not run parallel to some supplying line or does not run close to a power transformer.

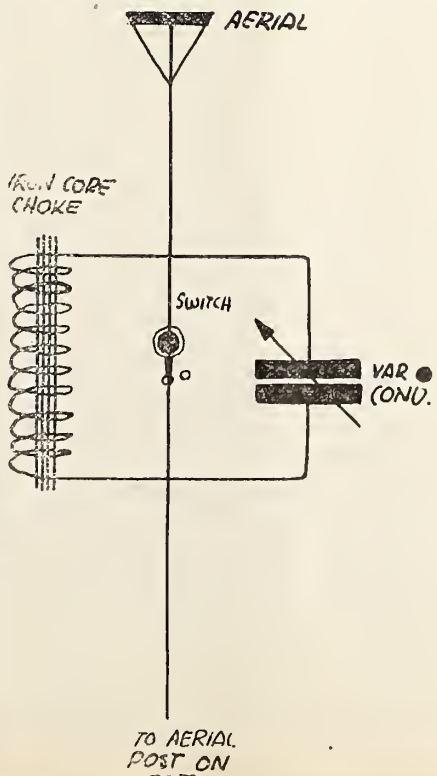


Figure 1

E. McG., Eau Galle, Wis.

Question: Here's shooting some questions at you. In the Hazeltine Neutrodyne circuit, I notice the tuning range is from 180 to 500 meters. How could it be made to reach 540 meters? What is your opinion of the latest Erla 3 tube reflex circuit? Is it better than the Neutrodyne? What I am after is the most efficient 2 RF detector and 2 AF set out. What is your answer from the many good circuits. I want ease of tuning and quiet or not too noisy while doing it, if possible. Is the Cockaday Four Circuit tuner a better circuit than the Reinartz?

Answer: The wave length range of the Hazeltine Neutrodyne circuit may be raised by the proper addition of additional turns on the transformers, more capacity in the condensers and the use of a larger coupler. Have not had any experience with the circuit mentioned, but if it is recommended by the Erla people, you will no doubt find it reliable. You will find a Reinartz circuit, of which I am enclosing a sketch of the type of circuit you desire. The Cockaday and Reinartz give about equal results, depending upon construction, operation and the location in which the set is operated. You will find the Reinartz easier to tune and operate, and less expensive to construct. The approximate wave length of the Cockaday set with the average antenna is from 550 to 180 meters.

I. J. H., Chicago, Ill.

Question: Would like to know if it is possible to obtain a copy of the Grimes Circuit with a list of the parts required to build the set. I am very much interested in radio and would like to get a diagram of a set that will receive from distant stations and also be able to tune out some of the local stations. I have built several sets from diagrams taken from different magazines, and none of them seem to be able to pick up distance. If you people have a diagram of a set that you believe to be good, please let me have a copy.

Answer: The description and circuit of the Grimes Inverse Duplex System was printed in the July issue of RADIO AGE. I am enclosing herewith a list of circuits of efficient nature which are all close tuning sets, but would advise that you construct the circuit marked X of which there appears a diagram in the September issue of RADIO AGE in the Troubleshooter section Figure 2. This with a trap or filter as described in the July issue, "Little Things that Help," section should make about the most efficient tuning arrangement I know of.

L. M. C., Washington, D. C.

Question: Will you please publish in your magazine a diagram showing me how to hook up an Atwater-Kent variocoupler and detector unit with a variometer and condenser of 23 plates. I have the above instruments but do not know how to assemble them, and would appreciate your help very much.

Answer: A circuit adaptable to your apparatus was published in the July issue of RADIO AGE on page 17, Figure six. The set is a very efficient one, and using the apparatus you mention, the set should have a substantial range.

E. J. D., Minneapolis, Min.

Question: I am located in Minneapolis, and am having trouble with interference from amateur stations. Please give me correct information on an ideal antenna.

Answer: In our June number of RADIO AGE an article was published on the design, construction and maintainance of wireless antennae, and would refer you back to that issue. If you are having trouble from amateur sources would advise the use of an aerial of about 35 to 40 feet in length and not over 35 feet high. With lead in, it should not exceed 65 feet. This will enable you to tune more sharply. With a regenerative tuner, such as shown in Figure 2 in the September Troubleshooter section, you should have no trouble in tuning them out. Or you might use a set such as was described in the April issue. Would prefer the three circuit set in connection with a wave trap as shown in the July number. Restrictions have been placed on all amateur stations, forbidding them to transmit between the hours of 7:30 and 10 p. m., local standard time, and during local church services.

W. F. K, Chicago, Ill.

Question: Will you please publish a diagram of the four-circuit tuner, showing two stages of audio frequency amplification, together with the switch arrangement employed by Mr. Cockaday, for controlling the tone. Will you also please advise if the W. D. 11 or W. D. 12 dry cell tubes can be used, and what changes, if any, are necessary to make their use possible.

Answer: Figure 4 shows the Cockaday four-circuit tuner with two stages of audio frequency amplification together with the tone control arrangement, which you will find very effective. The tone controller consists of a switch lever, three switch points and a fixed mica condenser of .001 M. F. capacity, connected as shown in the diagram. Dry cell tubes will not afford as great a volume when used as amplifiers, but this handicap can be greatly overcome by the use of a C battery in the grid circuit. This will enable you to use a heavy plate voltage and will step up the volume to a marked degree. Connect the C battery as shown in the diagram, taking care that the negative side of the C battery is toward the grid. An ordinary three-volt flashlight cell can be used for this purpose, as little current is drawn from the cell.

H. W. S., Philadelphia, Pa.

Question: I have completed the Grimes Inverse Duplex system and have had very good results in Philadelphia, but have been unable to pick up any out-of-town stations. If you can help me in any way I will appreciate it very much. I am using all the parts specified in RADIO AGE, and hope you can help me.

Answer: I am glad to learn that you are having good results on local stations, and before I go any further would like to remind you that it is still summer, and the weather is not as favorable to radio as it might be. First try rearranging the sequence of the bulbs, i. e. try the different tubes in different sockets. Reverse the transformer connections. Procure a variocoupler, and connect it in the usual way to the aerial, connecting the secondary in place of the loop. If the set is working properly, this should surely give the desired results, providing your location is favorable. If all of the above fail, tear down the set, and test the RF component for the best results, and adjust the plate battery of the detector tube until you get the signals you wish to hear.

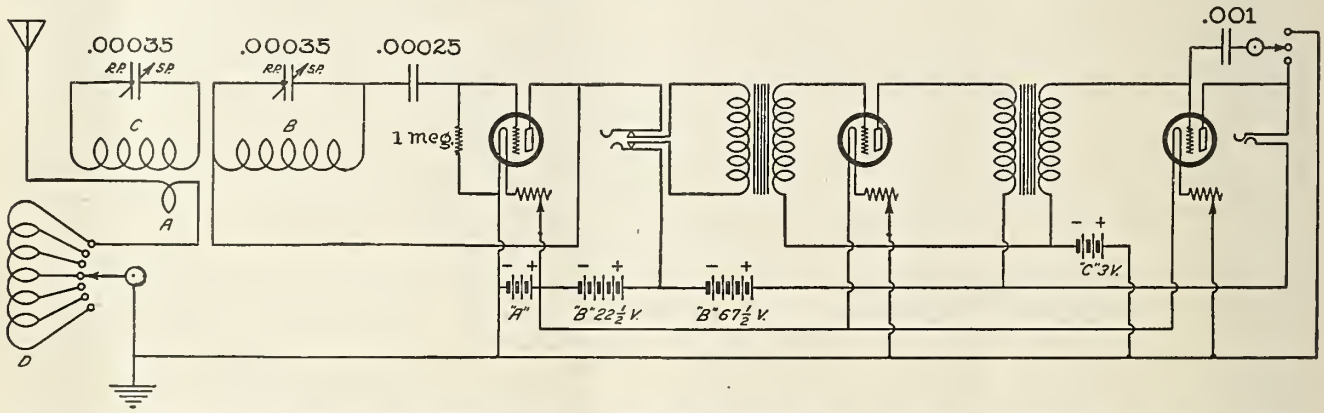


Figure 4. This shows the Cockaday Four Circuit Tuner in connection with the tone modifying arrangement and with C batteries, used when W D 11 tubes are used as amplifiers.

Pick-up Records by Our Readers

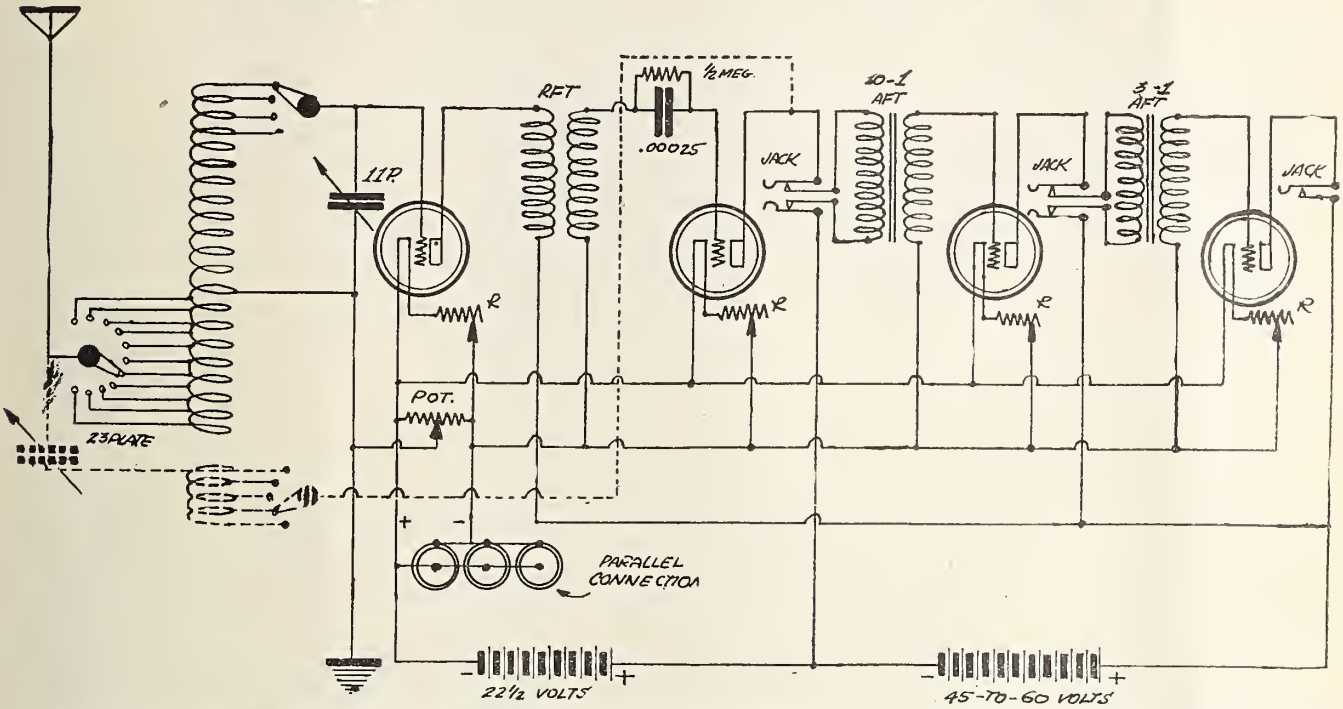


Figure 1. This is the Reinartz circuit, showing how Mr. Tuck changed the circuit by taking out the plate coil. This is indicated by the dotted lines.

THAT summer weather and Old Man Static couldn't phase some of the bugs is evinced by many letters from our interested readers. Many have been successful in hearing distant stations right through the worst atmospherics and fading, and write us that they had much fun in listening under adverse conditions. Now that ideal radio weather is prevalent and that our ranges are increasing "day by day in every way" we should be getting more pleasure and satisfaction out of the game. If you do any consistent or unusual DX work or have any helpful hints, drop us a letter with the detail concerning the matter, and let the rest of the BCLS hear about it. Don't forget that photos of your station are always welcome. Give us a buzz.

THE EDITOR.

RADIO AGE,
Gentlemen:

I wish to thank you for the hookup you sent me and to tell you what results I am having with it. I have heard the following stations with it in the single week since I got your information: WDAP, WSAI, WOAW, WOC, WFAA, WJAZ, WSB, and WMC. As the weather improves and conditions are more favorable, I expect to do even better. The stations here in town are all within six blocks of my set, and are going until late so I don't get much opportunity to do more. I have read every radio magazine sold at the news stands and I can truthfully say that RADIO AGE is *far* superior to any magazine I have as yet read or seen. Again thanking you for the hookup, I remain,

Yours very truly,
S. A. STEVENSON.
2590 Grand Avenue, Kansas City, Mo.

Mr. Stevenson's set is a simple one-tube circuit in connection with a one-stage audio frequency amplifier, It tickles the Technical man pink when he gets a letter showing that the fellows get good results from his suggestions, and we modestly thank Mr. Stevenson for his generous comment on RADIO AGE.

Even the fans up in Canada are wise to the value of RADIO AGE as a *real* radio magazine, Read the following letter from a Canadian BCL who lets the hookups appearing in RADIO AGE be his guide:

Gentlemen:

I have been using a Reinartz with two stages of Audio amplification since last September and have had wonderful success with the set. This month I decided to add one stage of radio frequency to the set, but after making the connections found that it would not work quite properly. My transformer is the best that can be bought and I took particular care to solder all points in the wiring. By accident I discovered that by throwing out the switch on the inner coil, and setting the feedback condenser at zero, I could not only get results but the stations came in much louder and clearer than ever, and the set tuned much sharper than I have ever heard it before. Today I removed the condenser and switch, also the wire to the plate of the detector tube and the music from Schenectady and Pittsburgh came in so loud that you would think the programs were being executed in the same room with you. It looks like a good improvement to me as the set is very selective and has only the one condenser to tune with. Stations come in one degree apart on the condenser, and do not cause interference. I would like to have Mr. Pearne give his opinion on the subject. I am enclosing a photo of my set which was taken before adding the Radio Frequency. The horn is from an old phonograph and I use a type C Baldwin receiver to make up the loud speaker. Last winter I heard, in all, sixty stations in the United States and Canada all on the loud speaker. Of course not all of them were loud enough to be of entertaining value.

I am enclosing herewith my subscription renewal as I think it has just about run out, and ask that you write me your opinion on the above as I value your judgment above *all* others having tried out several hookups recommended by your technical writers in RADIO AGE.

Very respectfully yours,
H. ORVILLE TUCK.
Box 164, Grimsby, Ontario, Canada.

A diagram of Mr. Tuck's set is shown in Figure 1. The photo of his station appears in Figure 2. That's clever stuff, Mr. Tuck, and we are certainly glad to have you continue as one of our readers. Mr. Pearne says that when the plate coil and feed-back condenser were removed, you removed the regenerative phase of the Reinartz set. Quoting the September issue PP 32:

"Regeneration when used with radio frequency does not always give gratifying results, and the experiment is left entirely to the judgment of the builder."

Fine business, Mr. Tuck. This is probably just what many of our readesr using this circuit are interested in trying, and we feel very grateful for your kind letter and comment.

Little Things That Help

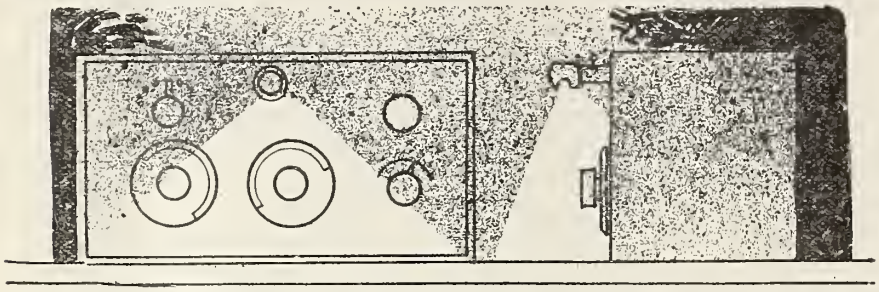


Figure 1. You can improve the appearance of your set by adding this simple accessory, at the same time solving a problem which has been the source of much trouble.

A Solution for the Fan's Electric Light Bill

By Mrs. Luella B. Lyon

A BCL, no matter what sort of lighting fuel he is consuming nightly, finds it a bit of worry. Lights keeping the family awake or the roomer with a radio and the landlady watching the transom to see how long the light burns and so on is, and has been a constant source of trouble. My husband determined to cut such a meter bill in half, and spent considerable time in devising a scheme that would do this cheaply and efficiently.

Eureka! He has at last found it. He has purchased one of those ordinary shaded dash lamps for an automobile and mounted it slightly above the center of our set as shown in Figure 1, where it throws out its beams from one end of the panel to the other. No more glaring lights when only a light for the operator is needed. This simple device is fastened on the panel by two small screws and the wires behind the panel coming from the storage battery. He believes in the near future all sets will be sold with these lamps on them and perhaps inverted into the panel, which would be even more desirable. The lamp draws so little current from the storage battery that its cost is negligible.

Read these letters from fellows who "Let our Hookups be Their Guide."

RADIO AGE,
Gentlemen:

After reading of a report of Mansfield, Ohio, receiving Omaha on one tube, using Reinartz hookup (August issue), I am prompted to advise you that I listened to WHAZ, WGY, WLAG, and WDAF on August 27, using Reinartz hookup with a U V 199 and dry cell batteries. This was during an electrical storm and the static was very bad, according to old-timers. I am a novice and had some trouble with my set as I built it from an article appearing in the ———— which was probably written before the change in wavelengths. I added two L 25 coils one each in the primary and secondary circuits and find it helped quite a bit. This was done according to the directions as appeared in the September number. The night I mention above was the first "silent" night here after I finished my set. I had the same stations on the 3rd of this month and in addition, listened to WOS at Jefferson City, Mo.

Very truly yours,
W. E. BENTLEY.

4431 North Maplewood Avenue, Chicago, Ill.

Mr. H. Robert, of 227 Union Street, Schenectady, N. Y., writes: "Please allow me to commend you for the plain drawings and hookups that appear in your paper from time to time,"

We are glad that we could help Mr. Bentley out, and wish to hear from him again. Thanks, Mr. Robert—we're glad you like our illustrations, and wish to say, that many others believe the only real way to get radio information is to read RADIO AGE, and *let our hookups be your guide.*

Here's a letter from a twelve-year old boy, evidently a radio bug to the core; RADIO AGE:

I think I can equal or pass up any records that have been made by people during the summer months and I know that I can sass Ross T. Hatton of Omaha, Nebr. It was the first time in two weeks that I tuned the set, which is a three-tube set, using two stages of audio frequency. Here's a list of seventeen stations I picked up on August 24:

WDAP WIP KYW KDKA WMAF WFI WLW WRC WHAS WOO WGY WJZ WEAR WHAZ WCX WHN and NAA.

It required only one hour and forty-eight minutes to do my stuff. I am twelve years old.

Very respectfully yours,
WILLIAM HABERCAM.
503 E. 35th Street, Baltimore, Md.

That's the detector's cat whisker, ain't it? A lot of old-timers will have to take a back seat for this little dyed-in-the-wool radio bug.

And you radio bugs with eight tube sets, plug in another stage of radio frequency and audio frequency and gnash your teeth while you read this one:

Hook-up Ideas Are Worth $1

EACH radio fan who experiments finds something about design or operation that will help his fellow fan. Send in your new hook-ups and other original devices, accompanied by clearly drawn diagrams. Radio Age will pay $1 for all such orignal articles and drawings used. Text should be limited to about two hundred words.

Helping the Fan Roll His Own

By Mrs. Luella B. Lyon

Dial pointers are not easily purchased at a small town dealer, so my husband solved his own problem by going to the local ten cent store, where he purchased a small box of aluminum-headed thumb tacks. He placed the tack in his small table vise and proceeded to file the head of the tack until it took on the shape of an arrow. The sharply pointed end was by far handier than glue, and enabled him to tack these arrows thus made directly into the panel above the dials in the manner shown in Figure 2. This pointer method improves operating, inasmuch as the degrees of the scale on the dial can be accurately recorded for station settings, and the stations can be tuned in at will by only setting the dials at the corresponding numbers.

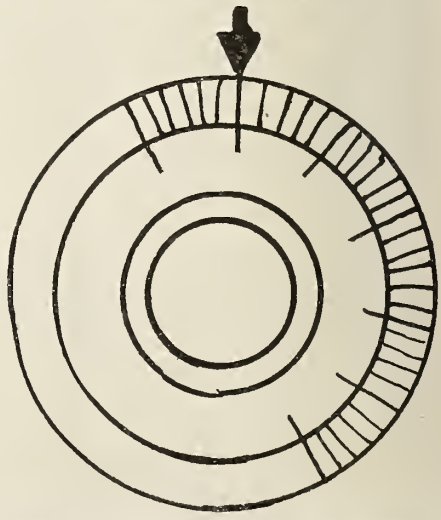


Figure 2. On homemade sets, the builder usually scratches an indicating mark on the panel. Here's another method of solving this really necessary operation.

Radio Saves Lives

An example of the value of auxiliary radio power in the form of batteries on seagoing vessels and the necessity of their frequent inspection, is found in the report on the total loss of the steamship "Advance."

When the "Advance" went aground off Halitax recently, the operator found that his power was cut off soon after grounding, as it was feared there might be a boiler explosion. This made it necessary for him to shift to his emergency batteries for transmitting S O S calls to ships and shore stations. His batteries stood up for one and a half hours, when it became necessary to abandon ship. All lives were saved, due to the bringing of aid by radio.

There would undoubtedly have been a loss of life if the batteries had not been in good shape.

View showing 125-foot antenna towers of Station KYW, on the roof of the Edison Building, Chicago. The top of these towers marks one of the highest points in the business district of Chicago. The wave length of KYW, is now 536 meters and it is one of the strongest in the country.

Learn Radio at Home

Earn $50 to $250 per week for fascinating, easy work; wonderful future in Radio. Thousands of new, big paying positions.

Easy to Learn at Home

You can easily and quickly become a "certified" *radio expert* through startling new method of National Radio Institute, one of the largest and oldest schools of radio in world. All instruction radio instruments loaned free. Employment service free to graduates.

Send for FREE BOOK "Your Opportunities in Radio"

Get full details of wonderful opportunities in Radio of thousands of our successful graduates, and of remarkable, easy method of learning Radio at home to qualify for high paid positions in this tremendous new field. Mail postcard *now* for 44-page Free Book and *Special Tuition offer* to those who enroll now.

National Radio Institute
Established 1914
Dept. 53-J
Washington, D. C.

Chicago's Show

The second annual Chicago Radio Show is getting under way with a speed which is surprising even to its backers. Although the doors of the famous Coliseum will not swing open on the exposition until November 20, more than half the space allotted for exhibitors has already been contracted for and the strongest program of features ever arranged for a radio show is rapidly taking shape.

More than sixty per cent of the exhibitors in the Chicago Radio Show last year have signified their intention of again taking space and the large number of applications received from new exhibitors has been a surprise. Manager James F. Kerr states that the six large spaces fronting on the main aisle were the first to go, being taken by the Chicago Radio Laboratory, Colin B. Kennedy, Frost, American Radio Research, Crosley and Grebe. Practically the whole center of the Coliseum was sold before September 15.

The show this year, in addition to being the largest manufacturers exposition ever held, will be featured by amateur displays planned to bring the attendance to a record point. For this reason contests have been arranged for the best homemade radio receiving set constructed by any amateur in the United States and for the most unique one tube or crystal set built by any school pupil in Cook County, Ill.

In the open amateur contest three prizes of $100, $75 and $50 will be awarded for the three sets judged best by a committee of radio engineers. In the contest for the most unique set three prizes of $50, $35 and $25 will be awarded a committee of competent judges. All of the winning sets will be shown at the show, along with other receiving sets showing all of the popular type of hook-ups.

"We have some other interesting and very unusual contests which we will announce in a short time and which will serve to interest most of the owners of receiving sets in the country," said Mr. Kerr. "From all indications the manufacturer, the jobber and the retailer are interested in the Chicago Radio Show. We intend to interest every radiophan, especially in the middle west. This is the great central market for radio just as much as for all other products and we want to get the trade into closer touch with the ultimate consumer."

There will be broadcasting from the show every afternoon and evening during the six days it is open, by means of sealed wires to one or more of the powerful broadcasting stations located in Chicago. The programs, which are already taking shape, will all be marked by unusual features.

Ten Good Rules

THERE are ten good rules for broadcast listeners:

1. Don't try to hear Australia in midsummer. Be satisfied to enjoy the nearer stations most of the time.

2. Don't be disappointed if an occasional storm interferes with your summer radio evening. There are many fine concerts coming. You can't expect to find a pearl in every oyster nor to receive a record-breaking concert every night.

3. If you want louder signals, use a longer aerial, more tubes, higher plate voltage, more sensitive loud speakers and careful tickler and receiver adjustment.

4. A pleasant signal filling a moderate size room should be enough to give satisfaction. It is not worth while producing signals which deafen the neighbors. It is wasteful to insist on tremendous signals which are generally less pleasant than moderate signals.

5. If your local station comes in too loudly and drowns others out, a smaller aerial will help in tuning him out, with a smaller condenser connected between aerial and ground. And if all measures to get rid of the local station fail, why not enjoy his concerts? He is working hard for you and it is nobody's fault that you are so close to him that you are bound to hear him. Broadcast stations have to be closer to some people than to others.

6. For the new longer waves above 450 meters, use a condenser connected between the aerial and ground terminals of your set.

7. A little patience in learning to handle your receiver yields rich returns in satisfaction from fine signals. Remember that "Rome wasn't built in a day" and keep on getting more and more familiar with your set and how it works.

8. It is a good idea to read the radio column of a newspaper or a good radio magazine or two. It helps you to know how your set works and keeps you up-to-date in radio. Information of this sort is an aid in getting the concerts loud and clear.

9. Ask your radio dealer for advice; he can probably tell you what you want to know and will be glad to do so. The manufacturer of your set also is willing to help you get the desired results from its use.

10. Do not throw away the direction sheets or booklet that came with your set and with the tubes. Read all such material carefully now and then. If you have lost the direction sheets, write to the dealer or manufacturer for another. The direction sheets must answer most of the questions which have been puzzling you and preventing you from getting the best out of your set.

If your newsdealer has sold out his supply of Radio Age you are likely to miss just the hook-up that you have been looking for. To avoid any such chance fill out the coupon in this issue and send in your subscription. Then you will be safe. And don't forget that with each subscription at the special price of $2.00 a year, or $1.00 for six months, we send you free the popular Reinartz Radio booklet FREE. Address Radio Age, 500 N. Dearborn Street, Chicago, Ill.

Dutch Radio

Radio telephony, particularly for amateurs, has enjoyed increasing popularity in the Netherlands during recent years. According to opinions in the trade, the next few years should see even greater development in amateur radio telephony in that country. The main activities in Holland are centered in the sale of parts and accessories, but the number of complete sets sold is relatively small, since most amateurs purchase the parts and erect their own stations.

According to best estimates there are at present no less than 4,000 amateur receiving stations in Holland; following the war there were only a score or more receiving stations. The management of Posts and Telegraphs advises that there are about 477 other receiving and transmitting wireless stations in the country.

Permits for receiving stations are readily granted in Holland. Dealers in radio materials are now negotiating with the government for authority to erect a general broadcasting station. The plan is to broadcast concerts and news on a much larger and better scale than is done at present by any Netherlands broadcasting service to amateurs.

Germany has been getting the bulk of Holland's import business, but the greater portion of German goods coming into the country are old war stocks. These goods cost usually anywhere from forty to fifty per cent below American and other competitors in price. Germany, of course, has advantages in the Netherlands on account of proximity of market.

The United States is gaining a better foothold in this market, however, and imports of radio material are increasing. Whereas in the full year 1919 the United States sent only $1,600 worth of radio material to this market, during the first half of the year 1923 there were $12,800 (normal) worth entered.

American goods will probably continue to enter the country on an improved scale, and competent members of the business express the opinion that if American parts and systems were made to conform more to local needs a much larger business would be done. American instruments in this market are as a rule designed for wave lengths averaging around 360 meters. In Holland most radio owners desire around 1,050 meters average and, in a good many cases, up to 2,000 meters is required.

Ready entry of radio material is provided for in Holland, since there are no governmental regulations or restrictions governing imports. The import duty on parts and whole sets is five per cent *ad valorem*.

New French Station

An attempt is being made by local business men in Marseilles, France, to establish a broadcasting station in collaboration with the newspapers of the city. A local dealer in French-made sets is said to be the prime mover in the project.

Complete Corrected List of U. S. and Canadian Broadcasting Stations

Complete Each Issue

THE list of broadcasting stations on these pages is brought up to date each month by additions of new stations and deletion of those which have suspended operation. The list is the product of a vast volume of correspondence and its completeness is due in large measure to the assistance of our special news service in Washington, D. C. Suggestions, corrections and additional data will be welcomed from readers. Broadcasters: Send in your program schedules.

IXAD, Pawtucket, R. I, 1000 miles; Special license experimental; Standard Radio & Electric Co.
KDKA, E. Pittsburg, Pa.; Class B station Westinghouse Elec. & Mfg Co.
KDDW, Steamship America, New York.
KDPM, Cleveland, Ohio Westinghouse Elec. & Mfg. Co.
KDPT, San Diego, Calif.; 244 meters; 50 watts; Southern Electrical Co.
KDYL, Salt Lake City, Utah; news music, entertainment, Telegram Publishing Co.
KDYM, San Diego, Cal.; Savoy Theatre; 252 meters 100 watts.
KDYQ, Portland, Ore.; Oregon Inst. Technology.
KDYS, Great Falls, Mont.; Class B, Great Falls Tribune.
KDYW, Phoenix, Arizona; Smith Hughes & Co.
KDYX, Honolulu, T. H; 12:15 to 1.15 p. m., stock reports and weather; 6:30 to 7:30 p. m., music, lectures; Sunday, 11 a. m. to 12:30 p. m., sermons; Honolulu Star-Bulletin, Ltd.
KDZB, Bakersfield, Calif.; Frank E. Seiffert.
KDZE, Seattle, Wash.; 455 meters; 500 watts; The Rhodes Co.
KDZF, Los Angeles, Calif.; Automobile Club of Southern California.
KDZI, Wenatchee, Wash.; Electric Supply Co.
KDZK, Reno, Nev. Wednesday 8 to 9 p m; Friday 8 to 9 p m. Musical and news features; Nevada State Journal, Nevada Machinery & Electric Co.
KDZQ, Denver, Colo. Pyle & Nichols, 1247 Broadway.
KDZR, Bellingham, Wash; 261 meters, 50 watts; Bellingham Pub. Co.
KFAD, Phoenix Ariz.; Class B, McArthur Bros. Mercantile Co.
KFAE, Pullman, Wash.; State College of Washington.
KFAF, Denver, Colorado; George S. Walker, Western Radio Corporation; musical programs, news items, etc., daily except Tuesday and Sunday, 8 to 9 p m; mountain standard time.
KFAJ, Boulder, Colo.; University of Colorado.
KFAN, Moscow, Idaho; Electric Shop.
KFAP, Butte, Mont.; Standard Pub. Co.
KFAQ, San Jose, Calif.; City of San Jose.
XFAR, Studio Lighting Service Co., Hollywood, California 280 meters, 200 watts.
KFAU, Boise, Idaho; Class B, Boise High School.
KFAV, Venice, Calif.; Abbott Kinney Co.
KFAW, Santa Ana, Cal.; 280 meters; 10 watts; Radio Den.
KFAY, Central Point, Ore.; W. J. Virgin Milling Co.
KFBB, Havre, Mont.; F. A. Buttrey & Co.
KFBC, Phoenix, Ariz.; Nielson Radio Supply Co.; 238 meters; 10 watts.
KFBE, San Louis Obispo, Calif.; R. H. Horn.
KFBG, Tacoma, Wash.. First Presbyterian Church.
KFBK, Sacramento, Calif., 283 meters; 100 watts; Kimball Upson Co.
KFBL, Everett, Wash.; Leese Bros.
KFBU, Thomas, Bishop, N. S., Laramie, Wyo.; 283 meters, 50 watts.
KFCB, San Diego, Calif.; 278 meters; 20 watts; W. K. Azbill.
KFCD, Salem, Ore.; F. S. Barton.
KFCF, Walla Walla, Wash.; Frank A. Moore.
KFCH, Billings, Mont; Elec. Service Station.
KFCK, Colorado Springs, Colo.; 242 meters; 10 watts; Colo. Springs Radio Co.
KFCL, Los Angeles, Calif.; Los Angeles Union Stock Yards.
KFCM, Richmond, Calif., Richmond Radio Shop.
KFCQ, Casper, Wyo., Motor Service Station.
KFCP, Ogden, Utah, Ralph W. Flygare.
KFCV, Houston, Tex., Fred Mahaffey, Jr.
KFCY, Le Mars, Ia.; Western Union College.
KFCZ, Omaha, Neb.; 258 meters; 100 watats; Omaha Central High School.
KFDA, Baker, Ore.; Adler's Music Store.
KFDB, San Francisco, Calif.; Mercantile Trust Co.
KFDD, St. Michael Cathedral, Boise, Idaho, 252 meters. 10 watts.
KFDH, Tucson, Ariz.; Univ. of Arizona.
KFDJ, Corvallis, Ore.; Oregon Agri. College.
KFDL, Denver, Colo.; Knight Campbell Music Co.
KFDO, Bozeman, Mont.; Everett H. Cutting.
KFDP, Des Moines, Ia.; Hawkeye Radio & Supply Co.
KFDR, York, Nebraska; Bullock's Hardware & Sporting Goods.
KFDS, San Francisco, Calif.; John D. McKee.
KFDU, Lincoln, Nebr; Nebraska Radio & Elect. Co.; 240 meters; 20 watts.
KFDV, Fayetteville, Ark.. Gilbrech & Stinson.
KFDX, Shreveport, La.; First Baptist Church.
KFDY, Brooking, S. D.; South Dakota State College of Agriculture and Mechanical Arts.
KFDZ, Minneapolis, Minn.; Harry O. Iverson.
KFEC, Portland, Ore., Meier & Frank Co.
KFEJ, Tacoma, Wash.; Guy Greason.
KFEL, Denver, Colo., Winnen Radio Corp.
KFEP, Denver, Colo., Radio Equipment Co.
KFEQ, Oak Nebraska; J. L. Scroggin.
KFER, Ft. Dodge, Iowa; 231 meters, 10 watts; Auto Electric Service Co.
KFEV, Douglas, Wyo; Radio Elect. Shop, 263 meters; 100 watts.
KFEX, Minneapolis, Minn; 261 meters, 100 watts Augsburg Seminary.
KFEY, Kellogg, Idaho; Bunker Hill & Sullivan Mining & Construction Co.
KFEZ, St. Louis, Mo.; American Society of Mechanical Engineers.
KFFA, San Diego, Calif.; Dr. R. C. Shelton.
KFFE, Pendleton, Ore.; Eastern Oregon Radio Co.
KFFO, Hillsboro, Oregon; Dr. E. H. Smith.
KFFP, Moberly, Missouri; First Baptist Church.
KFFQ, Colorado Springs, Colo.. Marksheffel Motor Co.
KFFR, Kirk, Jim, Sparks, Nev.; 226 meters, 10 watts.
KFFV, Lamoni, Iowa; Graceland College.
KFFX, Omaha, Neb; 278 meters, 250 watts; The McGraw Co.
KFFY, Alexandria, La; 275 meters; 100 watts; Pincus & Murphy Inc.
KFFZ, Dallas, Texas; 226 meters, 20 watts; A. G. Barnes Amusement Co.
KFGC, Baton Rouga, La; 254 meters, 100 watts; Louisiana State University.
KFGD, Chickasha, Okla.; 248 meters, 20 watts; Chickasha Radio & Elect. Co.
KFGF, Mt. Vernon, Wash.; Buchanan, Stevens & Co.
KFGH, Stanford Univ., Calif.
KFGJ, St. Louis, Mo.; 268 meters, 100 watts; Nat'l Guards Missouri 138 Infantry.
KFGL, Arlington, Oregon; Arlington Garage.
KFGP, Cheney, Kansas; 229 meters, 10 watts; Cheney Radio Company.
KFGQ, Boone, Iowa; 226 meters, 20 watts; Crary Hardware Co.
KFGV, Utica, Nebraska; 224 meters, 10 watts, Heidtorder Radio Supply Co.
KFGX, Orange, Texas; 250 meters, 500 watts; First Presbyterian Church.
KFGY, Baudette, Minn; 224 meters, 15 watts; Gjelhayg's Radio Shop.
KFGZ, Berrien Springs, Mich; 268 meters, 10 watts, Emmanuel Missionary College.
KFHA, Gunnison, Colo.; Colorado State Normal School.
KFHB, Hood River, Oregon, P. L. Boardwell.
KFHD, St. Joseph, Mo.; 226 meters, 10 watts; Utz Electric Co.
KFHF, Shreveport, La 268 meters, 150 watts; Central Christian Church.
KFHR, Seattle, Wash; Star Elect & Radio Co; 270 meters; 100 watts.
KFHM, Neah Bay, Wash.; Ambrose McCue.
KFHI, Wichita, Kansas; 224 meters, 20 watts; Charles V. Dixon.
KFHJ, Santa Barbara, Calif., Fallen Co.
KFHL, Oskaloosa, Ia.; 227 meters, 10 watts; Penn College.
KFHQ, Curtis Bros. Hardware Store, Los Gatos, Calif.; 242 meters, 5 watts.
KFHS, Dow, Clifford J., Lihue, Hawaii, 275 meters, 30 watts.
KFHS, Nelson, Robert Washington, Hutchinson, Kansas; 229 meters, 50 watts.
KFHU, Sateren, M. G., Mayville, N. D.; 261 meters, 50 watts.
KFHY, McEwan, R. S., Trinidid, Col.; 242 meters, 50 watts.
KFIB, St. Louis, Mo.; 214 meters, 10 watts; Franklin W. Jenkins.
KFID, Iola, Kansas, 246 meters, 20 watts; Ross Arbuckle's Garage.
KFIF, Portland, Ore., Benson Tech. Student Body.
KFIK, Gladbrook, Ia; Gladbrook Electric Co; 234 meters; 20 watts.
KFIO, Spokane, Wash.; North Central High School; 252 meters; 50 watts.
KFIQ, Yakima, Wash.; 224 meters, 50 watts; Yakima Valley Radio Broadcasting Association.
KFIU, Alaska Elect. Light & Power Co., Juneau, Alaska, 226 meters, 10 watts.
KFIV, Broyles, V. H., Pittsburg, Kansas; 240 meters, 20 watts.
KFIX, Reorganized Church of Jesus Christ, of Later Day Saints, Independence, Kans.; 240 meters, 500 watts.
KFIY, Seattle, Wash; 236 meters 15 watts; Brott Laboratories.
KFIZ, Fond du Lac, Wisc., 273 meters; 100 watts; Daily Commonwealth.
KFJB, Marshalltown, Ia., 248 meters, 10 watts; Marshalltown Electric Co. Inc.
KFJC, Seattle, Wash.; 233 meters; 100 watts; Post Intelligencer.
KFJD, Greeley, Colo.; Weld County Printing & Publishing Co; 236 meters; 100 watts.
KFJF Oklahoma City, Okla; 252 meters; 20 watts; Nat'l Radio Co.
KFJH, Selma, Calif.; 273 meters; 10 watts; The Sugar Bowl.
KFJI, Astoria, Ore.; 252 meters; 10 watts; Liberty Theatre.
KFJJ, Carrollton, Mo.; Carrollton Radio Shop; 236 meters; 50 watts.
KFJK, Bristow, Okla.; 233 meters; 100 watts; Delano Radio Elect. Co.
KFJM, Grand Forks, N. D., 229 meters, 100 watts; University of North Dakota.
KFJU, Kearney, Neb., 234 meters, 10 watts; Central Power Co.
KFJQ, Grand Forks, N. D., 252 meters, 5 watts; (portable Station), Radio Division of Valley Electric Co.
KFJR, Stevensville, Mont., 258 meters, 50 watts; Ashley C. Dixon & Son.
KFJX, Cedar Falls, Iowa, 229 meters, 50 watts; Iowa State Teachers College.
KFI, Los Angeles, Calif.; radius covers entire U. S. and Canada; Daily, 6:45 to 11 p. m. Sunday 10 to 11 a. m., 4 to 4:30 and 8 to 11 p. m.; entertainment and educational features; station operates three remote control stations; Earle C. Anthony, Inc.
KFKH, Denver Park Amusement Co; Lakeside, Colo; 226 meters, 10 watts.
KFU, Gridley, Calif.; The Precision Shop.
KFZ, Spokane, Wash.; Doerr-Mitchell Elec. Co.
KGB, Tacoma, Wash.; Mon. Wed. and Fri. 7 to 9 p m, News sport bulletins, lectures, entertainment, weather, tide tables, and time. Tacoma Daily Ledger, Tacoma, Wash.
KGG, Portland, Ore.; Hallock & Watson Radio Service.
KGN, Portland, Ore., Northwestern Radio Mfg. Co.
KGU, Honolulu, Hawaii, Waikiki Beach, Marion A. Mulroney; Honolulu Advertiser
KGW, Portland, Ore.; Oregonian Pub. Co.
KGY, Lacey, Wash.; St. Martin's College, (Rev. S. Ruth).
KHJ, Los Angeles, Calif.; Daily except Sunday; 12:30 p. m. to 1:15 p. m. news and concerts; 7 to 7:30 p. m. Children's Half Hour; 8 to 9:30 p. m. De Luxe program of music, news and educational features; Sunday: 10 to 11 a. m. Scripture reading, aermon, prayer and sacred musical program; Pacific time; Times-Mirror company.
KHQ, Seattle, Wash.; Louis Wasmer.
KJQ, Stockton, Calif.; C. O. Gould.
KJS, Los Angeles, Calif.; Bible Inst. of Los Angeles.
KLB, Pasadena, Calif; J. J. Dunn & Co.
KFDC, Spokane, Wash; Radio Supply Co.
KLN, Monterey Electric Shop, Monterey, Calif.; 261 meters. 10 watts.
KLS, Oakland, Calif.; Warner Bros.
KLX, Oakland, Calif.; Trihune Pub. Co.
KLZ, Denver, Colo.; Class B, 485, Reynolds Radio Co.
KMAZ, Macon, Ga., Mercer University.
KMC, Reedley, Calif.; Lindsay-Wetherill Co.
KMJ, Fresno, Calif. Max. 2576 Miles; Musical program, San Joaquin Light & Power Corp.
KMD, Tacoma. Wash., Love Electric Co.; Tacoma Times.
KNJ, Roswell, New Mexico; 250 meters; 150 watts; every evening at 8; news, weather reports, stock markets, concerts, sermons; Roswell Public Service Co.
KNT Aberdeen, Wash.. North Coast Products Co.
KNV, Los Angeles, Calif.; 256 meters; 20 watts; Radio Supply Co. of Cal.
KNX Los Angeles, Calif.; Electric Lighting Supply Co.
KOB, State College, N. Mex.; time signals and weather reports 12 noon and 10. p m. mountain time. music and lectures Monday, Wednesday and Friday, 7:30 to 8:30 p m; New Mexico College of Agriculture and Mechanical Arts.
KOE, Spokane, Wash.; Spokane Chronicle.
KDP, Detroit, Mich., Detroit Police Dept.
KDQ, Modesto, Calif., Modesto Evening News.
KPD, San Francisco, Calif., Hale Bros.
KQI, Berkeley, Calif., Univ. of California.
KQP, Hood River, Oregon; Apple City Radio Club.
KQV, Pittsburgh, Pa., Doubleday-Hill Elec. Co.
KQW, San Jose, Calif., Chas. D. Herrold.
KRE, Berkeley Daily Gazette, Berkeley, Cal.; 278 meters, 50 watts.
KSC, San Jose, Calif., O. A. Hale & Co.
KSD, St. Louis, Mo.; 1700 miles; grain, livestock, cotton, New York stocks, poultry and butter market, metal market, official weather and news at 9:40, 10:40, 11:40 12:40, 1:40, 2:40 and 4 p m; 8: p m 400 meters, musical and other features; Pulitzer Publishing Co., St. Louis Post Dispatch.
KSS, Long Beach, Calif., Frost & Dean Radio Research Lab.
KSU, Wenatchee, Wash.
KTW, Seattle, Wash., First Presbyterian Church.
KUS, Los Angeles, Cal. 500 miles; setting up exercises daily, 7 to 7:30 a m and 12:00 noon to 12:30 p m; concert, 65 voices, 6 to 6:45 p m, Wednesdays and Fridays. City Dye Works.
KUD, San Francisco, Calif., Examiner Printing Co., San Fran. Examiner.
KUY Del Monte, Cal., 256 meters, 50 watts; Coast Radio Co.
KWG, Stockton, Cal. Daily Market reports, music and news 4 to 5 p m; Music, 2 to 3 p m, Sunday; Tuesdays and Fridays, music, 8 to 9 p m. Portable Wireless Telephone Co.
KWH, Los Angeles, Calif., Los Angeles Examiner.
KXD Modesto, Calif., Herald Publishing Co.
KYQ, Honolulu, T. H., The Electric Shop.
KYW, Chicago, Ill.; Westinghouse Elec. & Mfg. Co. 345 meters.
KZM, Oakland, Calif., Western Radio Inst.; Preston D. Allen.
KZN, Salt Lake City, Utah, The Deseret News.
KZV, Wenatchee, Wash., Wenatchee Battery & Motor Co.
NDF, Anacostia, D. C., U. S. Navy Dept.
PWX, Havana, Cuba, Cuhan Telephone Co.
WABD, Dayton, Ohio; 286 meters, 10 watts; Parker High School.
WAI, Dayton, Ohio, McCook Field, U. S. Army.
WAAB, New Orleans, La., Valdemar Jensen.
WAAC, New Orleans, La., Tulane Univ.

(Continued on next page.)

Complete Corrected List of U. S. and Canadian Broadcasting Stations

WAAD, Cincinnati, Ohio, Ohio Mechanics Inst.
WAAE, St. Louis, Mo., St. Louis Chamber of Commerce.
WAAF, Chicago, Ill., Chicago Daily Drovers Journal.
WAAH, St. Paul, Minn.; Commonwealth Electric Co.
WAAK, Milwaukee, Wis., Gimbel Bros.
WAAL, Minneapolis, Minn., Minnesota Tribune Co. & Anderson-Beamish Co.
WAAM, Nswark, N. J. 200 miles; musical and code, every week day 11 to 11:55 a m, 3 to 4 p m; Wednesday evenings 8 to 9; I. R. Nelson Company.
WAAN, Colnmbia, Mo., Univ. of Missouri.
WAAP, Wichita, Kans., United Elec. Co.; Otto W. Taylor.
WAAS, Decatur, Ga., Georgia Radio Co.
WAAT, Jersey City, N. J., Jersey Review.
WAAW, Omaha, Neb., Omaha Grain Exchange.
WAAZ, Emporia, Kans.; Daylits 100 miles; nite 500-1000 miles; each Tuesday and Thursday from 7 to 8 p m. Acknowledge all communications at 7:15 p m. The Hollister Miller Motor Co.
WABB, Harrisburg, Pa; 286 meters, 10 watts; Dr. John B. Lawrence.
WABC, Anderson, Ind; 299 meters, 10 watts, Fulwider-Grimes Battery Co.
WABD, Dayton, Ohio; 286 meters, 10 watts; Parker High School.
WABE, Washington, D. C; 283 meters, 50 watts; Y. M. C. A.
WABF, Mt. Vernon, Ill; 234 meters, 250 watts; Mt. Vernon Register-News Co.
WABG, Jacksonville, Fla; Arnold Edwards Piano Co. 248 meters; 10 watts.
WABI, Bangor, Me: Bangor Railway and Elect. Co.; 240 meters; 50 watts.
WABJ, South Bend, Ind; The Radio Laboratories; 240 meters; 50 watts.
WABM, Doherty, F. E. Saginaw, Mich.; 254 meters, 100 watts.
WABD, Lake Avenue Baptist Church, Rochester, N. Y.; 252 meters, 30 wetts.
WAJT, Marshall, Me., Kelly-Vawter Jewelry Co.
WAJU, Yankton, S. D., Yankton College.
WABH, Sandusky, Ohio; 234 meters, 100 watts; Lake Shore Tire Co.

WBAA, W. Lafayette, Ind., Purdue University.
WBAD, Minneapolis, Minn., Sterling Elec. Co. & Journal Printing Co.
WBAE, Peoria, Ill., Bradley Polytechnic Inst.
WBAF, Moorestown, N. J., Fred M. Middleton.
WBAG, Bridgeport, Pa., Diamond State Fibre Co
WBAK, Harrisburg, Pa.; 360 meters; Pennsylvania State Police.
WBAM, New Orleans, La., J. B. Rennyson.
WBAN, Patrson, N. J., Wireless Phone Corp.
WBAO, Decatur, Ill.; 160 miles; occasional music; sermons; James Millikin Univ.
WBAP, Fort Worth, Tex.; 4000 miles; Markets and News; Feature concert Monday to Friday inslusive; 9:30 p m to 10:45 p m, Central Time; Quiet nights Saturday and Sunday. The Star-Telegram.
WBAQ, South Bend, Ind., Myron L. Harmon.
WBAU, Hamilton, Ohio, Republican Publishing Co.
WBAV, Columbus, Ohio, Erner & Hopkins Co.
WBAW, Marietta, Ohio; Marietta College; 246 meters; 100 watts.
WBAX, Wilkes-Barre, Pa., John H. Stenger, Jr.
WBBA, Newark, O.; 240 meter, 20 watts; Newark Radio Lab.
WBBC, Sterling, Ill; 229 meter, 50 watts; Sterling Radio Equipment Co.
WBBD, Reading, Pa; Barbey Battery Service; 224 meters; 50 watts.
WBL, Anthony, Kans; T & H Radio Co; 261 meters; 100 watts.
WBS, Newark, N. J.; Radius 500 mi.; Musical and Educational, week deys: 10:30 to 11 a. m.; 1:00 to 1:15 p. m.; 2:15 to 2:30 p. m.; 7:30 to 8:30 p. m.; Sundays: 9 to 10:30 a m; 1 to 3 p m; D. W. May, Inc.
WBT, Charlotte, N. C. 1200 miles; 11: a m weather report 485; 4:30 p m mechanical music; 8: p m Market Report; 8:30 Tuesday and Friday regular concert; 7:30 p m Sunday, Church Southern Radio Corp.
WBU, Chicago, Ill., City of Chicago.
WBZ, Springfield. Mass., Westinghouse Elec. & Mfg. Co.

WCAD, St. Lawrence University, Canton, N. Y.; 280 meters, 50 watts.
WCAE, Pittsburgh, Pa.; 12:30 news and reports; 3:30 weatehr reports; 4:15 Closing Market reports; 7:30 Late news and lecture; 8:30 musical programs; Kaufmann Baer Co.
WCAG, New Orleans, La., Daily Statss Pub. Co.
WCAH, Columbus, O. Daily program 11:30 to 12:30; Every Tuesday evening at 7, musical program; C. A. Entrekin Electric Co.
WCAI, San Antonio, Texas, Southern Equipment Co.
WCAJ, Univ. Place, Neb., Nebraska Wesleyan University.
WCAK, Houston, Texas, Alfred P. Daniel.
WCAL, Northfield, Minn., St. Olaf College.
WCAM, Villanova, Pa., Villanova College.
WCAO, Baltimore, Md., Sanders & Stayman Co.
WCAP, Chesapeake & Potomac Tel. Co., Washington, D. C.; 469 meters, 500 watts.
WCAR, San Antonio, Texas, Alamo Radio Elec. Co.
WCAS, Minneapolis, Minn., Wm. H. Dunwoody Industrial Inst.
WCAT, Rapid City, S. Dak., South Dakota School of Mines.
WCAU, Philadelphia, Pa.; 1000 miles; Daily 10:30 a. m.; 2:30 p. m.; 6:30 p m; regular concert 10 to 12 noon; Tuesdays, Fridays, Saturdays; Durham & Co., Inc.
WCAV, Little Rock, Ark., J. C. Dice Elec. Co.
WCAW, Omaha, Nebr., Woodmen of the World.
WCAX, Burlington, Vermont, University of Vermont.
WCAY, Milwaukee, Wis., Kesselman O'Driscoll Co.
WCBA, Allentown, Pa.; Chas. W. Halmbach; 280 meters; 5 watts.
WCBB, Greenville, O.; 240 meters, 100 watts; K. & K. Radio Supply Co.
WCBD, Voliva, Wilbur Glenn, Zion, Ill.; 345 meters, 500 watts.
WCE, Minneapolis, Minn., Findley Elec. Co.
WCK, St. Louis, Mo., Stix Baer & Fuller.
WCM, Austin, Texas, Univ. of Texas.
WCX, Detroit, Mich., Detroit Free Press.
WDAD, Lindsburg, Kas.; Central Kansas Radio Supply.
WDAE, Tampa, Fla., Tampe Daily News.
WDAF, Kansas City, Mo; Kansas City Star; 411 meters; 500 watts. Regular concerts on Mon, Wed. and Fri. nights from 8 to 9:30. Concerts from 3:30 to 4:30 p m each afternoon except Sun. Baseball scores 3:25, 4:00, 4:30, 5:00, and 5:50 p. m. Marketgram and weather forecast 5:55 nightly, except Sun. Educational features and musical program 6 to 7 o'clock each night except Sunday. "Nighthawk" Frolic, Coon Sanders orchestra at the Hotel Muehlebach nightly except Sun. 11:45 p. m. to 1 a. m.
WDAG, Amarillo, Texas, K. Laurence Martin.
WDAG, Brownsville, Pa., Hartman-Riker Elec. & Mach.Co.
WDAH, El Paso, Tex.; Trinity Methodist Church.
WDAJ, Ervins El. Co., Parson's, Kan. 258 meters, 15 watts.
WDAI, Syracuse, N. Y., Hughes Electrical Corp.
WDAK, Hartford, Conn., Hartford Courant.
WDAL, Jacksonville, Fla., Florida Times Union.
WDAO, Dallas, Texas, Automotive Elec. Co.
WDAP, Chicago, Ill., markets, and concerts 360; Daily on all business days: 9:30 a. m. receipts and shipments; estimeted car lots; local weather report; opening futures market in wheat, corn, oats, rye, barley, pork, lard and ribs. 10 a. m. Future quotations, live stock receipts and prices; 10:30 a. m. futures quotations; 11 and 11:30 a m. same; 12 noon, futures and cash grain prices; 12:30 and 1 p. m. futures quotations; 1:20 p. m. closing futures quotations and high and low for day. Cash grain prices. Gross bids for cash grain to arrive. 6 p. m. closing quotations; news itsms. On Saturdays closing prices at 12:05 p. m. instead of 1:20 p. m. Visible supply changes sent when posted. Regular concert schedule 10 p. m. Tuesdays, Thursdays and Saturdays. Sunday svenings 9 p. m. and 10 p. m. Chicago Board of Trade official station.
WDAR, Philadelphia, Pa.; Lit Brothers.
WDAS, Worcester, Mass., Samuel A. Waite.
WDAU, New Bedford, Mass., Slocum & Kilburn.
WDAX, Centerville, Iowa; First National Bank 268 meters, 100 watts.
WDAY, Fargo, N. D.; 244 meters, 50 watts; Fargo Radio Service Co.
WDBF, Phillips, Robert G., Youngstown, Ohio; 261 meters, 50 watts.
WDM, Washington, D. C., Church of the Covenant.
WDT, New York, N. Y., Ship Owners Radio Service.
WDZ, Tuscola, Ill., James L. Bush.
WEAA, Fallain & Lathrop, Flint, Mich.; 280 meters; 150 watts.
WEAB, Fort Dodge, Iowa, Standard Radio Equip. Co.
WEAE, Blacksburg, Va., Virginia Polytechnis Inst.
WEAF, New York City, N. Y., Western Electric Co.
WEAG, Edgewood, R. I., Nichols-Hinsline-Bassett Lab.
WEAH, Wichita, Kans.; 244 meters; 100 watts; Wichita Bd of Trads.
WEAI, Ithaca, N. Y., Cornell University.
WEAJ, Vermilion, S. Dak., University of South Dakota.
WEAK, St. Joseph, Mo., Julius B. Abercrombie.
WEAM, North Plainfield, N. J., Burough of N. Plainfield.
WEAN, Shepard Co., The, Providence, R. I.; 273 meters, 100 watts.
WEAO, Columbus, Ohio, Ohio State University.
WEAP, Mobile, Ala., Mobile Radio Co.
WEAQ, Berlin, N. H., Y. M. C. A.
WEAR, Baltimore, Md., Balt. American & News Pub. Co.
WEAS, Washington, D. C., The Hecht Co.
WEAU, Sioux City, Iowa, Davidson Bros. Co.
WEAY, Houston, Texas, Will Horwitz, Jr.
WEAZ, Waterloo, Iowa, Donald Redmond.
WEB, St. Louis, Mo., The Benwood Co., Inc.
WEV, Houston, Texas, Hurlburt-Still Elec. Co.
WEW, St. Louis, Mo., Market and weather reports at 9 a. m., 10 a. m., and 2: p m; no other regular program; St. Louis University.
WEY, Wichita, Kansas, Cosradio Co.
WFAA, Dallas, Texas. A. H. Belo & Co.
WFAB, Syracuse, N. Y., C. F. Weoso.
WFAC, Superior, Wis., Superior Radio Co.
WFAF, Poughkeepsie, N. Y., H. C. Spratley Radio Co.
WFAH, Port Arthur, Texas, Elec. Supply Co.
WFAJ, Asheville, N. C., Hi-Grade Wireless Instrument Co.
WFAK, Brentwood, Mo., Domestic Electric Co.
WFAM, St. Cloud, Minn., Granite City Elec. Co. and Times Pub. Co.
WFAN, Hutchinson, Minn., Hutchinson Electric Service Co.
WFAQ, Cameron, Mo., Cameron Radio Co. and Mo. Wesleyan College.
WFAT, Sioux Falls, S. Dak.; also Argus-Leader.
WFAV, Lincoln, Nebr., Univ. of Nebr. Dept. of Elec. Engineering.
WFI, Philadelphia, Penn., also Strawbridge & Clothier.
WGAC, Brooklyn, N. Y., Orpheum Radio Stores Co.
WGAD, Ensenada, Porto Rico, Spanish-American School of Radio-telegraphy.
WGF, Des Moines, Iowa 300 miles; Musical and entertainment Tuesday and Friday 7:30 p m; Church Services Sunday at 5 p m or 7:45 p m as announced; Special programs as announced Register and Tribune.
WGAJ, Shenandoah, Iowa, W. H. Gass.
WGAL, Lancaster, Pa.; Lancaster Elect. Supply Co. 248 meters; 10 watts.
WGAN, Pensacola, Fla., Cecil E. Lloyd.
WGAQ, Shreveport, La., Glenwood Radio Corp.
WGAR, Fort Smith, Ark., Southwest American.
WGAU, Wooster, Ohio; 226 meters, 20 watts; Marcus G. Limb.
WGAV, Savannah, Ga., B-H Radio Co.
WGAW, Altoona, Pa., Ernest C. Albright.
WGAY, Madison, Wis., North Western Radio Co.
WGAZ, South Bend, Ind., South Beno Tribune.
WGI, Medford Hillside, Mass., Am. Radio & Research Corp.
WGL, Philadelphia, Pa., Thos. F. J. Howlett.
WGR, Buffalo, N. Y., Federal Tel. & Teleg. Co.
WGV, New Orleans, La., Interstate Elec. Co.
WGY, Schenectady, N. Y., General Elec. Co.
WHA, Madison, Wis., Univ. of Wis.
WHAA, Iowa City, Ia; 500 miles; 8:30 p m, Monday, Instruction; Tuesday, concert, Wednesday, popular lecture: Friday, University News; public lectures and concerts irregularly; State University of Iowa.
WHAB, Galveston, Texas, Clark W. Thompson (Fellman's Dry Goods Co.)
WHAC, Waterloo, Iowa, Cole Bros. Elec. Co.
WHAD, Marquette Univ., Milwaukee, Wis.; 280 meters, 100 watts.
WHAG, Cincinnati, Ohio, Univ. of Cincinnati.
WHAH, Joplin, Mo; radius, 1384 mi.;Concerts, markets, weather, etc. Tuesday and Thursday evenings: 8 to 10; Daily except Sundays: 10 a. m. to 2 p. m.; Saturday night spedal: 11 to 12:30; Hafer Supply Co.
WHAI, Davenport, Iowa, Radio Equip. & Mfg. Co.
WHAJ, Bluefield, W. Va., Bluefield Daily Telegraph and E. K. Kitts.
WHAK, Clarksburg, W. Va., Roberts Hdwe. Co.
WHAL, Lansing, Mich., Lansing Capitol News.
WHAM, Rochester, N. Y. Daily—Weather reports 2:40 p. m.; Organ 2:45, 5:00, 6:45; Orchestra 3:00, 7:00; Bed-time stories, Sport results, Business reports and market reports, the latter on 485 meters, 7:15 p m; Sunday—Radio Chapel Service, 3:15 p m; University of Rochester.
WHAO, Savannah, Ga., Frederick A. Hill; every evening 8 to 9; Saturday nights, 12:30 1:30 a. m.
WHAP, Decatur, Ill., Dewey L. Otta.
WHAQ, Washington, D. C., Semmes Motor Co.
WHAR, Paramount Radio & Elect. Co., Atlantic City, N. J.;231 meters, 15 watts.
WHAS, Louisville, Ky., Courier Journal and Louisville Times Co.
WHAV, Wilmington, Del., Wilmington Elec. Spec. Co.
10 p m Wednesday evenings; Central Standard time; Iowa Radio Corp.
WHAY, Huntington, Ind., Huntington Press.
WHAZ, Troy, N. Y., Rensselaer Polytechnic Inst.
WHB, Kansas City, Mo., Sweeney Auto & Tractor School.
WHD, Morgantown, W. Va., W. Va. University.
WHK, Cleveland, Ohio, Warren R. Cox.
WHN, Ridgewood, N. Y., Times Printing & Pub. Co.
WHU, Toledo, Ohio, Wm. B. Duck Co.
WHX, Des Moines, Iowa; 300 miles; 5:45 p m to 6:15 p m Daily; 8:00 p m to
WIAB, Joslyn Automobile Co., Rockford, Ill.; 252 meters, 50 watts.
WIAC, Galveston, Texas, Galveston Tribune.
WIAD, Ocean City, N. J., Ocean City Yacht Club.
WIAF, New Orleans, La; G. A. DeCortin, 10 Marlborough Gate; 234 meters, 10 watts.

WJAG, Norfolk, Nebr; 200 miles News and Markets 12:15, 3:30 and 5:30 p. m. The Huse Publishing Co. The Norfolk Daily News.
WIAH, Newton, Iowa, Continental Radio & Mfg. Co.
WIAI, Springfield, Mo., Heer Stores Co.
WIAJ, Neenah, Wis., Fox River Valley Radio Supply Co.
WIAK, Omaha, Nebr.; 7:45 a. m. Livestock receipts; 9:10 a. m. Livestock receipts and opening on hogs; 10:15 a m rainfall and temperature report and weather forecast for Nebraska and Iowa, Livestock market; 12 m cattle, hog and sheep market; 1:50 p m rainfall and temperature report and weather forecast for Nebraska and Iowa; market detail; 3:50 p m complete market reports and estimated receipts for next day; Daily Journal-Stockman.
WIAO, Milwaukee, Wis., School of Engineering.
WIAP, Springfield, Mass., Radio Development Corp.
WIAQ, Marion, Ind.; 226 meters; 10 watts; Chronicle Publishing Co.
WIAR, Paducah, Ky., Musical 3:30 to 4 p. m. and 7 to 8 p. m. except Sundays. Paducah Evening Sun; Albert Bennett, operator.
WIAS, Burlington, Iowa, Hawk-Eye Home Elec. Co.
WIAT, Tarkio, Mo., Leon T. Noel.
WIAU, Le Mars, Iowa, Am. Trust & Savings Bank.
WIAY, Neenah, Wis; 224 meter, 100 watts; Fox River Valley Radio Supply Co.
WIK, McKeesport, Pa., 234 meters, 500 watts; K&L Electric Co.
WIL, Washington, D. C., Continental Elec. Supply Co.
WIP, Philadelphia, Pa., Gimbel Bros.
WJAB, Lincoln, Nebr., American Radio Co.
WJAD, Waco, Texas. Jackson's Radio Engrng. Lab.

(Continued on next page.)

Complete Corrected List of U. S. and Canadian Broadcasting Stations

WJAF, Muncie, Ind; 1800 miles; 7:30 to 8 Monday, Wednesday, Friday evening. music; 6:30 to 7 p m Saturday, music; 3:30 to 4 every afternoon, News; 10:30 to 12 M Sundays, Church service. Smith Electric-Muncie Press.
WJAM, Cedar Rapids, Ia; D. C. Perham, 268 meters, 20 watts.
WJAK, Greentown, Ind., 254 meters, 30 watts; Rev. C. L. White.
WJAN, Peoria, Ill; 280 meters, 100 watts; Daily except Sunday; 9 a. m. Peoria Livestock; 9:15 a. m. Special Weather information; 11:30 a. m. weather, opening livestock and market quotations; 1:30 p. m. Closing livestock and markets, official weather information; talk to women by Phyllis Ann; Monday and Thursday, government agriograms; 5:30 p. m. baseball reports during season; Tuesday, Thursday and Saturday, special concerts as announced at 9:15 p. m.; One musical number preceeds each broadcasting. Peoria Evening Star.
WJAQ, Topeka, Kans., Capper Publications.
WJAR, Providence, R. I., The Outlet Co., J. Samuels & Bros.
WJAS, Pittsburgh, Pa., Pittsburgh Radio Supply House.
WJAT, Marshall, Mo., Kelley-Vawter Jewelry Co.
WJAX, Cleveland, Ohio, Union Trust Co.
WJAZ, Chicago, Ill., Chicago Radio Lab.
WJD, Granville, Obio; 229 meters, 50 watts; Richard Harris Howe.
WJH, Washington, D. C., White & Boyer Co.
WJX, New York, N. Y., De Forest Radio Telephone & Teleg. Co
WJZ, New York, Radio Corp. of America; Aeolin Hall, 455 meters.
WKAA, Cedar Rapids, Ia.; Daily; weather reports, crop reports, government reports; Mondays, Thursdays and Saturdays; music; H. F. Paar. 268 meters, 100 watts.
WKAC, Lincoln, Nebr; Star Publishing Co; 275 meters; 100 watts.
WKAD, Looff, Charles, East Providence, RI.; 240 meters, 10 watts.
WKAF, Wichita Falls, Texas, W. S. Radio Supply Co.
WKAN, Montgomery, Ala., Alabama Radio Mfg. Co.
WKAP, Cranston, R. I., Dutee W Flint.
WKAQ, San Juan, Porto Rico. Radio Corp. of Porto Rico
WKAR, Michigan Agri. College, East Lansing, Mich., 280 meter, 100 watts.
WKAS, Springfield, Mo., L. E. Lines Music Co.
WKAV, Laconia, N. H., Laconia Radio Club.
WKAW, Beloit, Wis; 242 meters, 10 watts; Turner Cycle Co.
WKAX, Bridgeport, Pa; W. A. McFarlane; 231 meters; 15 watts.
WKAY, Gainesville, Ga., Breoau College.
WKC, Baltimore, Md., Jos. M. Zamoiski Co.
WKY, Oklahoma City, Okla., Oklahoma Radio Shop.
WLAC, Raleigh, N. C., N. C. State College.
WLAG, Minneapolis, Minn., Cutting & Walsh Radio Corp.
WLAH, Syracuse, N. Y., Samuel Woodworth.
WLAJ, Waco, Texas, Waco Elec. Supply Co.
WLAK, Bellows Falls, Vt., Vermont Farm Machine Co.
WLAL, Tulsa, Okla., Tulsa Radio Co.
WLAN, Houlton, Me.; 283 meters; 250 watts; Putnam Hardware Co.
WLAP, Louisville, Ky., W. V. Jordan.
WLAQ, Kalamazoo, Mich., A. E. Schilling.
WLAT, Burlington, Iowa, Radio Specialty Co.
WLAV, Pensacola, Fla.; daily musical program, 8 to 9 p m; The Electric Shop.
WLAW, New York, N. Y., New York Police Dept.
WLAX, Greencastle, Ind., Greencastle Community Broadcasting Station.
WLAZ, Warren, Ohio, Huttor & Jones Elec. Co.
WLB, Minneapolis, Minn., Univ. of Minn.
WLW, Cincinnati, Ohio, Crosley Mfg. Co.
WLZ, Fairfield, Ohio, U. S. Army.
WMA, Anderson, Ind., Arrow Radio Lab.
WMAB, Oklahoma City, Okla., Radio Supply Co.
WMAC, Cazenovia, N Y; J. Edw. Page; 261 meters; 50 watts.
WMAE, Dartmouth, Mass., Round Hills Radio Corp.
WMAH, Lincoln, Nebr., General Supply Co.
WMAJ, Kansas City, Mo., Drovers Telegram.
WMAK, Lockport, N. Y., Norton Labs.
WMAL, Trenton, N. J, 100 miles; 7:30 to 9 p m, Mondays and Thursdays, musical programs, lectures etc; Trenton Hardware Co.
WMAN, First Baptist Church, Columbus, Ohio; 286 meters; 20 watts.
WMAN, Columbus, Ohio, First Baptist Church.
WMAP, Easton, Pa., Utility Battery Service.
WMAQ, Fair Store Building, Chicago; 4:35 to 5 p m, daily; 7 to 7:30 p m, Monday, Wednesday, Friday and Saturday; 7 to 8 p m, Tuesday and Thursday; 9:15 to 10 p m daily; Chicago Daily News and Fair Department Store.
WMAT, Paramount Radio Corp., Duluth Minn.; 266 meters, 25 watts.
WMAV, Anburn, Ala., Polytechnic Inst.
WMAZ. Macon, Ga., Mercer University.
WMAY, St. Louis, Mo.; 280 meters, 10 watts; religious services, Sunday 11 a. m. and 8 p. m. Tuesday at 7 p. m. Kingshighway Presbyterian Church.
WMC, Memphis Commercial Appeal; Memphis, Tenn.
WMH, Cincinnati, Ohio, Precison Equipment Co.
WMU, Washington, D. C., Doubleday-Hill Electric Co.
WNAC, Boston, Mass.; Monday 4 to 5 p. m. (silent at night) Tuesday 4 to 5 p. m. and 7 to 8:30 p. m. Wednesday 4 to 5 p. m. 9:30 to 11 p. m. Thursday 4 to 5 and 7 to 8:30 p. m. Friday 4 to 5 and 8 to 9:30 p. m. Saturday 4 to 5 and 9:30 to 11 p. m. The Shepard Stores; J. J. Fanning, announcer Samuel Curtis, operator, 278 meter, 100 watts.
WNAD, Norman, Okla., Okla. Radio Engineering Co.
WNAL, Omaha, Nebr., R. J. Rockwell.
WNAN, Syracuse, N. Y., Syracuse Radio Telephone Co.
WNAP, Springfield, Ohio, Wittenberg College.
WNAQ, Charleston, S. C., Charleston Radio Elec. Co.
WNAS, Austin, Texas, Radio Corp.
WNAT, Philadelphia, Pa, 1000 miles; Talks, Radio information, music, Chapel Service. Wednesday 7:30 p m; Saturday 7:30 p m; Sunday 2:30 and 4:30; Every day 12:15, 1 p m. Lennig Bros. Co.
WNAV, Knoxville, Tenn., People's Tel. and Tel. Co.
WNAW, Fortress Monroe, Va., Henry Kunzman.
WNAX, Yankton, S. Dakota; 244 meters, 100 watts; Dakota Radio Apparatus Company.
WNAY, Baltimore, Md., Shipowners' Radio Service.
WNJ, Albany, N. Y., Shotton Radio Mfg. Co., Inc.
WOAA, Ardmore, Okla.; radius 1,500 miles; Tuesdays and Fridays; musical and educational programs; Dr. Walter Hardy; station operated by G. H. Reitz.
WOAB, Grand Forks, N. D.; 280 meters; 10 watts; Valley Radio Co.
WOAC, Lima, Ohio, Maus Radio Co.
WOAE, Fremont, Nebr., Medland College.
WOAF, Tyler, Texas, Tyler Commercial College.
WOAH, Charleston, S. C., Palmetto Radio Corp.
WOAI, San Antonio, Tex; 385 meters; Southern Equipment Company; Programs Daily; 10:30 a m Opening markets, U S weather forecast, crop reports, road reports, cotton reports, money market, livestock quotations and news bulletins, daily except Sun. 12:15 p m. Livestock quotations, produce markets, and news bulletins. 3 p m Closing markets, cotton reports, grain and market futures and news bulletins. 7 p m Complete baseball scores from American National and Texas leagues, final reports on markets, and news bulletins. Daily except Sun. 9:30 to 10:30 p m Concerts. Thurs. 7:30 to 8:30 p m Musical and Community Programs. Sunday 11:00 a m Church Services, 5:00 to 6:00 p m Concerts.
WOAK, Frankfort, Ky., Collins Hardware Co.
WOAL, Webster Groves, Mo., 286 meters, 100 watts; William Evans Woods.
WOAN, Lawrenceburg, Tenn., James D Vaughan
WOAO, Omaha, Nebr. 100 miles; Woodmen of the World.
WOAQ, Portsmouth, Virginia; Portsmouth Kiwanis Club.
WOAR, Kenosha, Wis., Henry P. Lundskow.
WOAT, Wilmington, Del., Boyd Martell Hamp.
WOS, Jefferson City, Mo. Missouri State Marketing Bureau; 441 meters, 500 watts; first fifteen minutes of every hour from 8 a. m. to 2 p m.; markets and music at 5 p. m. Monday, Wednesday and Friday nights, 8 to 9:30 concerts. No Sunday program.
WOAV, Erie, Pa., Pa. Nat'l Guard.
WOAW, Omaha, Neb. 100 miles; Woodmen of the World.
WOAX, Trenton, N. J., Franklin J. Wolff.
WOAZ, Stanford, Texas, Penick Hughes Co.
WOC, Davenport, Ia. time signals, 10:55 a. m.; weather 11 a. m.; 360 meters, 11:05 opening market quotations, agriograms; 12:00 noon, chimes concert; 2:00 p m, closing stocks and markets; 3:30 p m, educational talk; 5:45 p m chimes concert; 6:35, sandman's visit; 7:00 musical program; 8 p m, lecture; Sundays, religious and musical and religious features. 9 a m to 10 p m; Palmer's School of Chiropractic.
WOI, Ames, Ia., Iowa State College.
WOK, Pine Bluff, Ark., concerts Tuesday and Friday evenings beginning at 9; Sundays, song service and sermons from churches at 11 a. m. and 7:30 p. m., Arkansas Light & Power Co.
WOO, Philadelphia, Pa., John Wanamaker.
WOQ, Kansas City, Mo., Western Radio Co.
WOR, Newark, N. J., L. Bamberger & Co.
WOV, Omaha, Nebr., R. B. Howell.
WPA, Fort Worth, Texas, Fort Worth Record.
WPAB, State College, Pa.
WPAC, Okmulgee, Okla., Donaldson Radio Co.
WPAD, Chicago, Ill., Wieboldt & Co.
WPAF, Council Bluffs, Iowa, Petersen's Radio Co.
WPAG, Independence, Mo., Central Radio Co.
WPAH, Waupaca, Wis., Wisconsin Dept. of Markets.
WPAJ, New Haven, Conn., Doolittle Radio Corp.
WPAK, Fargo, N. D., North Dakota Agricultural College.
WPAL, Columbus, Ohio, Superior Radio & Tel. Equip. Co.
WPAM, Topeka, Kans., Awerbach & Guettel.
WPAP, Winchester, Ky., Theo D. Phillips.
WPAO, Frostburg, Md., General Sales & Eng. Co.
WPAQ, Wilmington, Del., Radio Installation Co., Inc.
WPAR, Beloit, Kans., R. A. Ward.
WPAT, El Paso, Texas, St. Patrick's Cathedral.
WPAU, Moorhead, Minn., Concordia College.
WPAZ, Charleston, W. Va., Dr. John R. Koch.
WPG, New Lebanon, O. Nushawg Poultry Farm; 234 meters, 50 watts.
WQAA, Parkersburg, Pa. 1500 miles; 10:30 p m every evening. Horace A. Beale, Jr.
WQAB, Springfield, Mo., Southwest Missouri State Teachers' College.
WQAC, Amarillo, Texas. E. B. Gish.
WQAD, Waterbury, Conn., Whitall Electric Co.
WQAE, Moore Radio News Station, Springfield, Vermont; 275 meters, 50 watts.
WQAF, Sandusky, Ohio, Sandusky Register.
WQAH, Lexington, Ky., Brock-Anderson Elect. Eng Co
WQAL, Cole County Tel. & Tel. Co., Mattoon, Ill.; 258 meter, 10 watts.
WQAM, Miami, Fla., Electrical Equipment Co.
WQAN, "The Voice of Anthracite," 280 meters, 150 watts; Scranton Times, Scranton, Pa., musical and informative programs thrice daily; 12:30, 4:30 and 7:30 p. m. except Sunday. Music, news, weather forecasts and reports baseball scores, market quotations, evening bedtime stories. Special musical programs by vaudeville and other artists on Tuesday and Friday evenings at 8 p. m.
WQAO, New York, N. Y., Calvary Baptist Church.
WQAP, Lincoln, Nebr., Am. Radio Co.
WQAQ, Abilene, Texas. West Texas Radio Co.
WQAR. Muncie. Ind., Press Publishing Co.
WQAS, Lowell, Mass.; Prince-Walter Company.
WQAV, Huntington & Guerry, Inc., Greenville, S. C.; 258 meters, 15 watts.
WQAW, Washington, D. C; Catholic University of America; 236 meters; 50 watts.
WQAX, Peoria, Ill.; Radio Equipment Co.
WQAZ, Greensboro, North Carolina; Greensboro Daily News.
WRAA, Houston, Texas, Rice Institute.
WRAB, Savannah, Ga.; Savannah Board of Public Education.
WRAF, Laporte, Ind; 224 meters, 10 watts; Radio Club, Inc.
WRAD, Marion, Kas.; 248 meters; 10 watts; Taylor Radio Shop.
WRAH, Providence, R. I.; Stanley N. Read.
WRAL, St. Croix Falls, Wis.; Northern States Power Co.
WRAM, Carthage, Ill., Robert E. Compton & Carthage College.
WRAN, Grover, Waldo C., La Crosse, Wis.; 234 meters, 100 watts.
WRAO, St. Louis, Mo., Radio Service Co.
WRAP, Winter Park, Fla.; Winter Park Electric Construction Co.
WRAR, David City, Nebr; J. C. Thomas; 226 meters; 20 watts.
WRAS, McLeansboro, Ill.; Radio Supply Co.
WRAU, Amarillo, Texas, Daily News.
WRAV, Yellow Springs, O., Antioch College.
WRAW, Good, Horace D., Reading, Pa.; 238 meters, 10 watts.
WRAX, Flexon's Garage, Gloucester City, N. J.; 268 meters, 50 watts.
WRAY, Scranton, Pa.; radius 400 mi.; Sunday Chapel service; Wednesday; Selective Musical program, 8:15 to 10; Saturday; 8:15 to 11; Radio Sales Corp., 280 meters, 100 watts.
WRAZ, Radio Shop of Newark, Newark, N. J. 233 meters, 50 watts.
WRC, Washington, D. C.; Radio Corporation of America, 469 meters, 500 watts.
WRK, Hamilton, Ohio, Doron Bros. Elec. Co.
WRL, Schenectady, N. Y., Union College.
WRM, Urbana, Ill., Univ of Ill.
WRR, Dallas, Texas, City of Dallas, Police and Fire Signal Dept.
WRW, Tarrytown, N Y; Tarrytown Radio Research Lab; 275 Meters; 50 watts.
WSAB, Cape Girardeau, Mo., Southeast Mo. State College.
WSAC, Clemson College, S. C.; Clemson Agricultural College.
WSAG, Davis, Loren V., St. Petersburg, Fla.; 244 meters, 10 watts.
WSAH, Chicago, Ill.; A. G. Leonard, Jr.; 248 meters, 500 watts.
WSAJ, Grove City, Pa. Grove City College.
WSAK, Daily News, The, Middleport, Ohio; 258 meters, 20 watts.
WSAL, Brookville, Ind.; Franklin Electric Co.
WSAN, Allentown Radio Club, Allentown, Pa.; 229 meters, 10 watts.
WSAP, New York City; Seventh Day Adventist Church.
WSAQ, Round Hills Radio Corp., Dartmouth, Mass.; 280 meters, 100 watts.
WSAR, Doughty & Welch Elect. Co., Fall River, Mass.; 254 meters, 10 watts.
WSAT, Plainview Elect. Co., Plainview, Texas; 268 meters; 20 watts.
WSAU, Chesham, N. H.; 229 Meters; 10 watts; Camp Marienfield.
WSAW, Canandaigua, N. Y.; 275 Meters; 100 watts; Curtice & McElwee.
WSB, Atlanta, Ga., Atlanta Journal.
WSL, Utica, N. Y., J. & M. Elec. Co.
WSY, Birmingham, Ala., Alabama Power Co.
WTAB, Fall River Daily Herald, Fall River, Mass.; 248 meters, 10 watts.
WTAC, Johnstown, Pa., Penn. Traffic Co.
WTAD, Carthage, Ill.; 229 meters; 50 watts; Robert E. Compton.
WTAF, New Orleans, La.; 242 meters; 20 watts; Louis J. Gallo.
WTAH, Belvidere, Ill., 236 meters, 10 watts; Carmen Ferro.
WTAJ, Portland, Maine, 236 meters, 50 watts; The Radio Shop.
WTAL, Toledo, O., 252 meters, 10 watts; Toledo Radio and Electric Co.
WTAN, Matoon, Ill., 240 meters, 100 watts; Orndorff Radio Shop.
WTAS, Elgin, Ill; 275 meters, 500 watts; Chas. E. Erbstein.
WTAU, Tecumseh, Neb., Ruegy Battery & Elec. Co.
WTAW, College Station, Texas; Ag'c'ltle & Mech. College; 254 meters; 50 watts.
WTG, Manhattan, Texas, Kans. State Agri. College.
WVP, New York, N. Y. Signal Corps, U. S. Army.
WWAC, Waco, Tex; 3000 miles; Weather forecasts 11 a m daily; musical concerts, daily, 1:30 p m and on Wednesday and Saturday evenings at 8; Sanger Bros.
WWAD, Philadelphia, Pa., Wright & Wright, Inc.
WWAX, Laredo, Texas, Worman Bros.
WWB, Daily News Print Co., Canton, Ohio; 268 meters, 200 watts.
WWI, Dearborn, Mich., Ford Motor Co.
WWJ, Detroit, Mich., Evening News.
WWL, New Orleans, La.; Loyola University; 280 meters; 100 watts.

(Continued on page 32)

Complete Corrected List of U. S. and Canadian Broadcasting Stations

Canadian Stations

CFAC, Calgary, Alta., Can. Western Radio Co., Ltd.
CFCA, Toronto, Ont., Can. Toronto Star.
CFCS, Vancouver, B. C., Can. Marconi Co.
CFCE, Halifax, N. S., Can. Marconi Co.
CFCF, Montreal, P. Q., Can. Marconi Co.
CFCH, Iroquois Falls, Ont., Can. Abitibi Power & Paper Co., Ltd.
CFCI, Walkerville, Ont., Can. Motor Products Corp.
CFCN, Calgary, Alta., Can. W. W. Grant Radio, Ltd.
CFCX, London, Ont., Can. The London Advertiser.
CFPC, Fort Frances, Ont., Can. International Radio Develop. Co.
CFTC, Toronto, Ont., Can. The Bell Telephone Co.
CFYC, Vancouver, B. C., Can. Victor Wentworth Odium.
CFZC, Montreal, Que., Can. Can. Westinghouse Co., Ltd.
CHSC, Calgary, Canada. W. W. Grant Radio, Ltd. (Morning Albertan.)
CHCA, Vancouver, B. C., Can. Radio Corp. of Vancouver, Ltd.
CHCB, Toronto, Can. Marconi Co.
CHCC, Edmonton, Alta., Can. Can. Westinghouse Co., Ltd.
CHCF, Winnipeg, Man., Can. Radio Corp. of Winnipeg, Ltd.
CHCQ, Calgary, Alta., Can. Western Radio Co., Ltd.
CHCS, London, Ont., Can. London Radio Shoppe.
CHCX, Montreal, Que., Can. B. L. Silver.
CHCZ, Toronto, Ont., Can. Globe Printing Co.
CHOC, Vancouver, B. C., Can. Can. Westinghouse Co., Ltd
CHVC, Toronto, Canada. Metropolitan Motors Co.
CHXC, Ottawa, Ont., Can. J. R. Booth, Jr.
CHYC, Montreal, Que., Can. Northern Elec. Co.
CJSC, Montreal, Que., Can. Dupuis-Freree.
CJCA, Edmonton, Alta., Can. Edmonton Journal, Ltd.
CJCS, Nelson, B. C., Can. James Gordon Bennett.
CJCD, Toronto, Can., T. Eaton, Co.
CJCE, Vancouver, B. C., Can. Vancouver Sun.
CJCF, Kitchener, Ont., Can. News Record, Limited.
CJGG, Winnipeg, Canada. Manitoba Free Press.
CJCH, Toronto, Ont., Can. United Farmers of Ontario.
CJCI, St. John, N. B., Can. McLean, Holt & Co., Ltd.
CJCN, Toronto, Ont., Can. Simone, Agnew & Co.
CJCS, Halifax, N. S., Can. Eastern Telephone & Telegraph Co.
CJCY, Calgary, Alta., Can Edmund Taylor.
CJGC, London, Ont., Can. London Free Prese.
CJNC, Winnipeg, Man., Can. Tribune Newspaper Co.
CJSC, Toronto, Ont., Can. Evening Telegram.
CKAC, Montreal, Can. La Preese.
CKCB, Winnipeg, Man. Can. T. Eaton Co., Ltd.
CKCD, Vancouver, B. C., Can. Vancouver Daily Province.
CKCE, Toronto,Ont., Can. Can. Ind. Telephone Co.
CKCK, Regina, Sask., Can. Leader Pub. Co.
CKCR, St. John, N. B., Can. Jones Elec. Radio Co., Ltd.
CKCS, Montreal, Que., Can. The Bell Telephone Co.
CKCZ, Toronto, Ont., Can. Westinghouse Co., Ltd
CKKC, Toronto, Ont., Can. Radio Equipment & Supply Co., Ltd.
CKOC, Hamilton, Ont., Can Wentworth Radio Supply Co., Ltd.
CKQC, London, Ont., Can. Radio Supply Co.
CKZC, Winnipeg, Man., Can. Salton Radio Eng. Co.

Funds for U. S. Radio

When the next session of congress takes up for consideration the appropriations to be made for the conduct of the federal government during the coming fiscal year, a greatly increased appropriation will be asked for the operation of the radio division of the Department of Commerce, which today is struggling along on funds but little greater than those available three and four years ago when broadcasting, as we know it today was non-existent.

If the radio division is to perform its functions efficiently, at least $100,000 more than is now appropriated will be necessary, it is believed. A greatly increased force of inspectors is needed if the broadcasting stations and amateur plants are to be checked up properly. At present, practically all of the time of inspectors on the coast is required for the inspection of ship stations and similar government work, and they are hard pressed for the time in which to make these necessary inspections of other stations. The recent reallocation of wave lengths, however, makes it necessary that every station be extremely sharp on its wave, if there is to be no interference, and careful checking up of the wave length used is necessary.

Few persons not connected with the work of the Department of Commerce realize what the district inspectors are doing. Many of them are out of bed and ready for their day's work before the last "ham" has signed off for the night. They travel great distances; most of them have automobiles for facility in covering their territory and run the speedometer up many hundreds of miles in the course of a month. All sorts of work come to the radio inspectors; the checking of broadcasting stations and the inspection of ship plants is but a part of their labor. Many complaints are received, some well founded and some imaginary; but all must be investigated, at a great expense of time.

Practically every inspector is heavily overworked, and it is the desire of officials in Washington to give them such assistance as may be necessary for them to carry on all of the many operations which go to make up an inspector's day. At the same time, the Washington offices are none too well supplied with labor, and hard work and long hours are necessary for the handling of the great mass of data, reports, complaints, letters, applications, etc. which pour in in a steady stream.

New Pamphlet

A publication giving an introduction to the subject of line radio communication has just been prepared, under the direction of the Chief Signal Officer of the army, in cooperation with the Bureau of Standards. The pamphlet gives an explanation of how messages are carried to distant points by radio frequency currents directed over ordinary telephone lines or power wires. The fundamental principles of radio and its relation to line radio telegraphy and telephony are discussed.

Copies of the work, known as Signal Corps Radio Communication Pamphlet, No. 41, and entitled, "Introduction to Line Radio Communication,' can be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C. at ten cents a copy.

Big Press Station

The Canadian Department of Marine has issued a license for the erection of a high-powered press radio station at St. Margaret's Bay, Nova Scotia, near Halifax, to C. F. Crandall of the British United Press, acting for the American Publishers' Committee. For over a year a group of American papers, including New York, Philadelphia, Chicago and other dailies, has been operating an experimental radio station at Dartmouth, across the bay from Halifax, for the reception of wireless press reports from London and Europe, and relaying them by land lines to the newspapers. The project will now be made permanent, a dispatch from Consul General Gunsaulus states.

Station in Balkans

Work has been started on a new 100-kilowatt radio station at Rakovica about four kilometers from Belgrade and on a receiving station at Laudon Trench, a suburb of that city. The station is being built by the French Wireless Telegraph Company and the total expense is estimated at 38,000,000 dinars ($402,800 at rate of exchange of September 1). On its completion the entire installation will be taken over by the state and the operating personnel will become employes of the Department of Posts and Telegraphs, the company maintaining one engineer as a technical adviser.

This particular station will be the first high power radio installation in the Balkans and because of the greatly increased facilities which it will afford for the dissemination of news and the rapid dispatch of information, it should soon become well known internationally, says Consul K. S. Patton, in a report to the Department of Commerce.

WGY Reaches Iceland

WGY is the first American radio broadcasting station to be heard in Iceland. In May, Snorri P. B. Arnar, chief radio operator at Reykjavik, 2,600 miles from Schenectady, N. Y., picked up the General Electric Company station regularly, sometimes strong enough to operate a loud speaker.

The Schenectady station has been heard at greater distances than Iceland but never before so far north, chiefly because of the limited number of stations in the thinly populated country. WGY has been heard in France, in Chile and in Hawaii.

Broadcasting a Book

Station WJZ, of the Radio Corporation, has been conducting an interesting entertainment feature by serializing William Johnston's Mystery novel, "The Wedding Cipher." A chapter is broadcast each Thursday evening at 8:45, central time, from the station in Aeolian Hall, N. Y.

Radio to Guide Zeppelin

By CARL H. BUTMAN

(Copyright 1923)

Washington, D. C.—Early in November, it is expected that the Zeppelin Company will point the nose of the great German-built ZR-3 toward the west and the long overseas journey of the navy's second airship will begin. On her maiden trip to her American home at Lakehurst, N. J., a distance of approximately 3,600 nautical miles, radio will guide this latest Zeppelin.

She will not be under radio control, as was the old battleship "Iowa," when sunk by naval gunfire, but radio will carry to her twice daily complete forecasts of the weather ahead and the meteorological conditions on the southern trans-Atlantic steamship route along which, it is understood, she will proceed under the direction of the German officers and crew. The only American officer who is certain of making the trip over is Captain G. W. Steele, U. S. N., her future commander, but it is possible that Commander Garland Fulton, Lieutenant Commander S. N. Kraus and Lieutenant R. G. Pennoyer, naval observers at Friedrichshafen, may be among the passengers.

Briefly, the characteristics of the new aerial passenger cruiser (she is not a war craft, at least, not yet) are: length 660 feet, slightly less than the American built ZR-1; diameter 90 feet; power, four 400-hp Maybach engines, giving a speed of approximately eighty miles an hour. In one sentence, she is the last word in old-world airships and it will be interesting to witness a comparison and test with the new world's ZR-1, with which ship she will share the gigantic double hangar at the Lakehurst Naval-Air station.

Although the United States has no control over this craft during her flight over the Atlantic, nor, in fact, until she is officially delivered to the Navy as a reparation ship, the government is to cooperate in paving the way on her first cruise. Through arrangements between the weather bureau, navy, shipping board vessels and certain other north Atlantic ships, meteorological data from all along her route will be compiled and radioed twice a day to a station ship in mid-Atlantic. This vessel will have a powerful radio set and will transmit to NAA, Arlington, Va., bulletins for broadcasting to the ZR-3, both before and during her flight.

All details have been arranged between the navy and the weather bureau. The plan includes the receipt of storm warnings, forecasts and statements of weather both at sea and ashore which might in any way affect the passage of the great airship. Observations will start a full week before the craft leaves Germany, and the reports will be on the air until she is housed in her hangar.

Little is known of the radio equipment of the ZR-3 but it is said that it is of the latest German radio development, and that transmission and reception is assured all the way across the Atlantic, although half that range would be sufficient due to the cooperation of the station ship and NAA.

CORRECTION.

Sept. 7, 1923.

Radio Age,
500 North Dearborn St.,
Chicago, Ill.

Gentlemen:

On page 19 of the September issue of RADIO AGE you state that the capacity of .00005 microfarad can be obtained by connecting two .00025 microfarad condensers in series. I wish to call your attention to this mistake as the resultant capacity would be .000125 and not .00005.

On page 15, T. F. W., of Chicago, states that the hydrometer always registers 1200 after charging his Edison battery. I think that it would have been advisable in your answer to inform T. F. W. that a hydrometer reading of an Edison battery is no indication of its degree of charge as the specific gravity of the solution in the Edison battery does not change during charge or discharge. The voltmeter test is the only reliable one for an Edison battery. It might be well to caution readers against using a hydrometer to test Edison batteries as they are very apt to use a hydrometer which has been previously used to test a lead storage battery in which case some of the remaining acid would be introduced into the Edison battery with detrimental effect.

Trusting that you will accept these criticisms in the spirit in which they are given, I remain

Yours very truly,
K. E. HASSEL.

Zenith Incorporates

The Zenith Radio Corporation has been formed with a capitalization of $500,000, all common stock at a par value of $10. The new corporation has a contract to act as the exclusive selling agents of the Zenith long distance receiving and sending apparatus, manufactured by the Chicago Radio Laboratory, one of the original Armstrong licensees.

E. F. McDonald, Jr., is president and treasurer; Thomas M. Fletcher is vice president; N. A. Fegen is secretary, S. I. Marks is assistant treasurer and the directors are J. R. Cardwell, U. J. Herrmann and Irving R. Allen.

Announcement by Mr. Fegen says: "The Chicago Radio laboratory is now enlarging its factory and manufacturing facilities to enable it to take care of an output of 300 sets a day. All indications are that the demands will be so great this fall that the principal problem will be a matter of production, and the orders now on hand indicate the tendency of the buying public towards higher priced, better grade radio receiving instruments.

"We are expecting daily to hear of others to bear out our prophecy that the season 1923-24 will not only be the greatest radio season ever known, but will also be a stepping stone to future years with steadily increasing volume."

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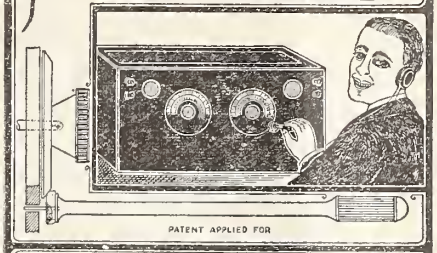

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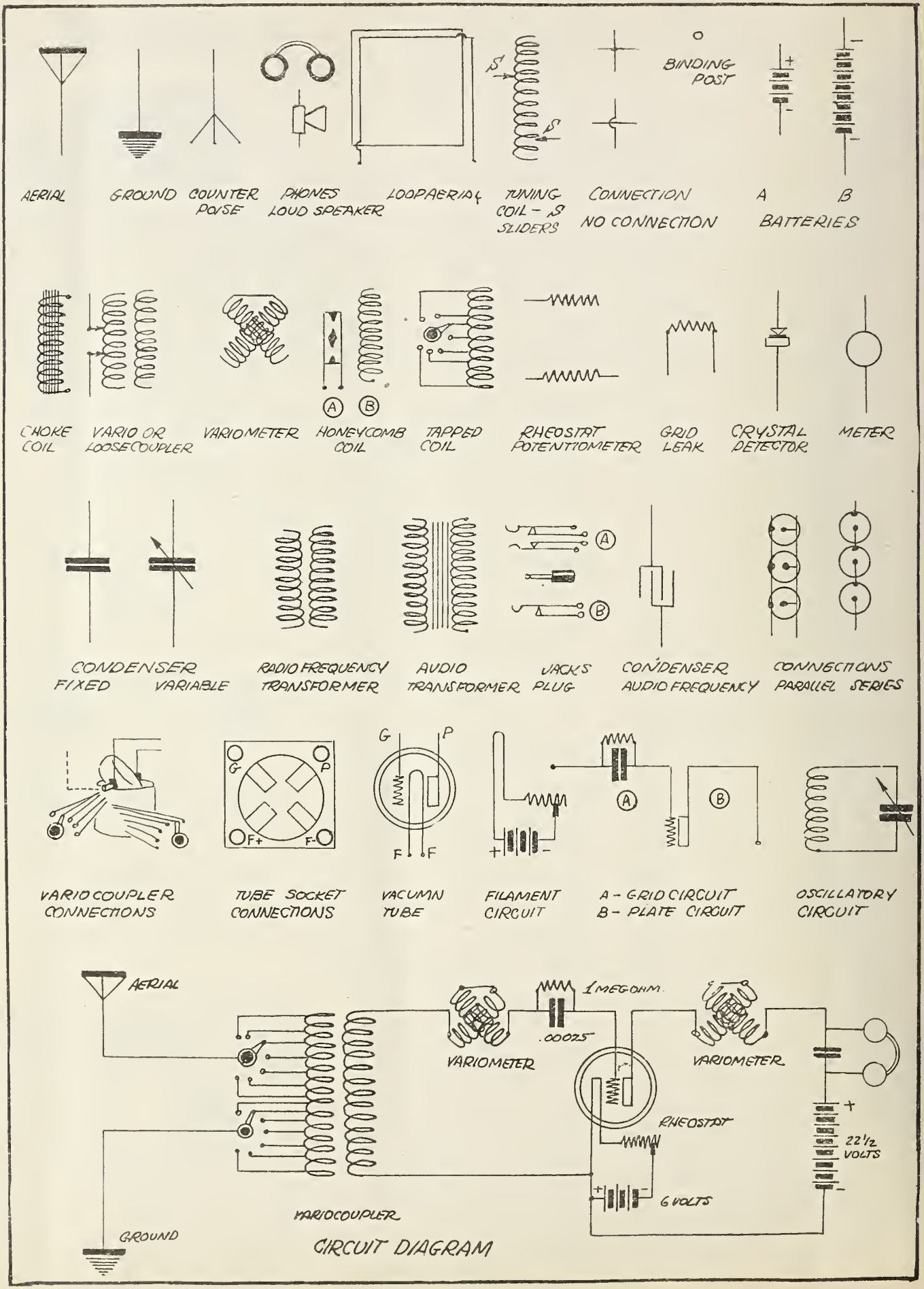
AERIAL
GROUND
COUNTER POISE
PHONES LOUD SPEAKER
LOOP AERIAL
TUNING COIL – S SLIDERS
CONNECTION
NO CONNECTION
BINDING POST
A BATTERIES
B BATTERIES
CHOKE COIL
VARIO OR LOOSE COUPLER
VARIOMETER
HONEYCOMB COIL
TAPPED COIL
RHEOSTAT POTENTIOMETER
GRID LEAK
CRYSTAL DETECTOR
METER
CONDENSER FIXED
CONDENSER VARIABLE
RADIO FREQUENCY TRANSFORMER
AUDIO TRANSFORMER
JACKS
PLUG
CONDENSER AUDIO FREQUENCY
CONNECTIONS PARALLEL
CONNECTIONS SERIES
VARIO COUPLER CONNECTIONS
TUBE SOCKET CONNECTIONS
VACUMN TUBE
FILAMENT CIRCUIT
A – GRID CIRCUIT
B – PLATE CIRCUIT
OSCILLATORY CIRCUIT
AERIAL
1 MEGOHM
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VARIOMETER
VARIOMETER
RHEOSTAT
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6 VOLTS
VARIOCOUPLER
GROUND
CIRCUIT DIAGRAM

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What Will Your Set Look Like Five Years From Now?

(*Continued from page 7.*)

Since then various additions have been made until the set evolved into the arrangement shown in figure 2. This set was a marvelous success, judging from records made at that time, the writer having heard every district (radio division) in the United States, Canada and ships on the Atlantic Ocean.

Even some of the sets now in use using similar circuit—the Armstrong regenerative—have not anywhere near compared with this range, which is probably due to the increased interference caused by the many new stations and receivers.

The lower cabinet was a homemade variocoupler variometer set, with the upper cabinet one of the old types of amplifiers of the two-stage variety that the Chicago Radio laboratory used to make, (they made good apparatus way back, too) of the 1920 vintage.

The transmitter was increased to a quarter kilowatt spark, and its signals were heard over 800 miles from Chicago. Later this was replaced by one KW spark which was used until last winter when the writer realized that broadcast listeners were to be considered—rather they had to be, inasmuch as they threatened to cut down the sixty-foot masts used to support the antenna for the station. The cards on the wall are cards from other amateurs who heard signals from this station, and reported them.

A continuous wave transmitter is now being built for use next winter, and various circuits are being tried out, to find the best broadcast and amateur set possible.

The set shown in Figure 2 has been replaced by a three-circuit type using Amrad parts, with a rebuilt amplifier of the Zenith type. The best receiving record on broadcasting of this set is KHJ at Los Angeles, Calif., and of amateur stations in every district.

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The Second Annual CHICAGO RADIO SHOW, to be held in the Coliseum from Nov. 20 to 25, inclusive, will award the following prizes in two contests open to amateur builders of radio receiving sets.

For the most unique crystal or one-tube receiving set built by any student in any public or parochial school in Cook County, Ill.:

First Prize.....	$25.00
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First Prize.....	$75.00
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All sets entered in these contests to be exhibited in the Show. For further details and Entry Blanks write to Contest Dept., Chicago Radio Show, 127 North Dearborn Street, Chicago, Ill.

The amateur exhibit will be in addition to the exhibits of all the leading radio manufacturers. Manufacturers who have not as yet obtained their allotment of space are advised to get into immediate communication with the management of the SHOW.

OFFICE:
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127 No. Dearborn Street

JAMES F. KERR
Manager
Telephone State 4161

A Marvelous Trio

(*Continued from page 9.*)

There are three elements in the vacuum tube, filament, grid and plate, which are the vital parts of the receiving tube and, when connected into the receiving circuit in the proper way, act together to produce from the incoming electrical disturbance a form of energy which can be connected into a reproduction of the original sound initiated at the broadcasting station.

The exact action by means of which this result is obtained is rather complicated and is exceedingly difficult to discuss without the aid of diagrams or some such way of visualizing the process. At best, under the conditions imposed in a description of this kind, it is possible to give only a very rough idea of the physical phenomena, which are concerned in the action of the tube.

To begin with, in order to receive with a tube, the filament must be heated by passing an electrical current through it. When a metallic substance is heated in a vacuum it shoots out from its surface millions of extremely minute particles which are called electrons. These electrons are small negative charges of electricity, the smallest known subdivisions of matter and upon them the whole action of the tube is dependent. The filament is there for the sole purpose of shooting these electrons out into the space in the bulb where they can be made use of.

Having heated the filament of the WD-11 tube to a very dull red, we have a condition where electrons are being evaporated out of the filament at a rate determined by the temperature of the metal, and if the electrons have no place in particular to go, an equilibrium condition is reached where the filament is surrounded by a cloud of electrons which are in a state of constant agitation and change, a number coming out of the filament and an equal number returning to it each second.

Now let the plate be connected through the telephone receivers to the positive pole of a 22 1-2 volt battery, called the B battery. The negative pole of this battery is connected to one end of the filament. The plate is therefore "positive" in potential and the negative particles of electricity coming out of the filament are attracted towards the plate just as unlike poles of a magnet are attracted to each other. A stream of negative particles of electricity is pulled from the filament into the plate, and an electrical circuit is thereby completed, so that the B battery is forcing a current through a circuit containing the telephones and the space between plate and filament.

But in the space between plate and filament is the grid which normally allows the stream of electrons to flow freely through its mesh to the plate. If a voltage is applied to the grid, however, the stream of electrons will be deflected so that some of them go to the grid or are driven back to the filament, and the amount of current flowing between filament and plate is thus varied. Any variation in this current means a variation in the current through the telephone receivers and this of course means a sound. Therefore, an electrical impulse impressed on the grid of the tube appears as sound in the telephone receivers.

Station 9CPJ, built and operated by Charles G. Pelton of the Black Hawk Electric Company, of Waterloo, Iowa. 25 Watt C. W. 10 watt phone. With the receiver Mr. Pelton has picked up California, Canadian and New York stations.

It is this property of the structure of the tube which makes it possible to perceive with the ear the results of the electrical impulses intercepted by your antenna. The antenna with its tuning system is connected in such a way that the variations of electrical energy which form the incoming signal are impressed on the grid of your tube. Because of the way in which the electron stream is controlled, a very small amount of energy impressed on the grid will make a relatively large variation in the energy in the plate circuit which is supplied by the B battery. The incoming signal on the grid is therefore able by the control of this local source of energy to actuate the telephones much more strongly than would be the case of this amplifying property were not present, or the amplified energy in the plate circuit may be applied to the grid of a second tube and amplified again.

Because of this same amplifying property, the principle called "regeneration" may be employed. In this method of using the tube, the incoming energy is used to produce variations in the B battery energy in the plate circuit as described; and then part of this energy variation is taken out of the plate circuit and fed back onto the grid of the same tube where it again produces variations in the plate current which add to the variations previously obtained. In

this way, a feeble incoming signal may be reinforced and strengthened to produce a relatively large quantity of sound when it finally is converted into that form of energy. It is by the use of this regenerative action of the tube that stations operating at great distances can be heard with a single tube.

It will immediately appear that a further use of the amplifying property of the tube makes possible the building up of a signal which is barely audible in head telephones, until it is loud enough to furnish music for a large room.

To accomplish this result, the energy variation which actuates the telephone in the ordinary detector set is made to pass through the primary winding of a transformer or through a high resistance. The variations of voltage across the high resistance or across the secondary terminals of the transformer are impressed on the grid of a second tube. These voltage variations produce variations in the energy in the plate circuit of the second tube which are much greater than the variations in the plate circuit of the first tube, and which can be converted into sound by means of telephone receivers or can be used to actuate still another tube with corresponding amplification in the plate circuit of the last tube. In this way a signal can be built up without distortion to produce a volume of sound immensely greater than the feeble note you hear in the telephone receivers of your detector set.

The development of the WD-11 bulb, with its dry cell filament, by doing away with the necessity of the bulky and inconvenient storage battery for filament lighting, has placed the tube set upon such a footing that its use is entirely practicable for all home receiving stations.

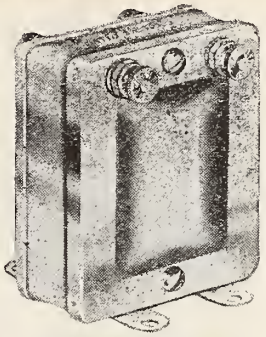
Broadcasting at Limit

For the first time in many months no new broadcasters sought licenses for stations during the week ending September 8. This is a confirmation of predictions of Secretary Hoover and his radio aides that the saturation point has really been reached. That 567 were enough broadcasters nearly everyone agreed in August, and few regret that the number has fallen off four.

The point now established is that evidently those who contemplated entering the field also recognized this fact and refrained from taking out licenses. The activity in September was the least since February, 1922, but indicates a better state of stability in the broadcasting field.

During August, seven new stations came into being, thirteen transferred from Class C to Class A, and eleven ceased operation. This leaves the present number of broadcasters at 563 stations, a large percentage of which are good, reliable stations, likely to survive some time.

One Class B station, well known WGY, transferred from its classification to Class D, covering broadcasting development, and now shares this honor with Pittsburgh's KDKA.



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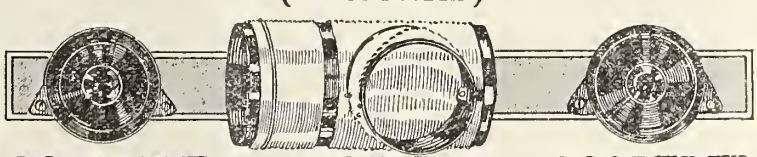

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Your First Tube Set

(*Continued from page 6.*)

honey-comb coil together with the other minor tube accessories make a circuit of a very efficient nature. The variometer is placed in the plate circuit as shown in Figure 5 and a 23-plate condenser is used to tune the secondary circuit. A 25-turn honeycomb coil is used to raise the wave of the circuit to enable the builder to apprehend the present higher waves now in use. Of all the circuits shown, the long distance crystal offers the greatest tuning possibilities.

Figure 6 illustrates how a two circuit crystal set using the loose or variocoupler connections are changed to accommodate the tube attachment. The circuit is practically the same as that of the long distance crystal, excepting that the plate circuit is not tuned. The only additional apparatus necessary is the bulb, batteries and the corresponding tube controls.

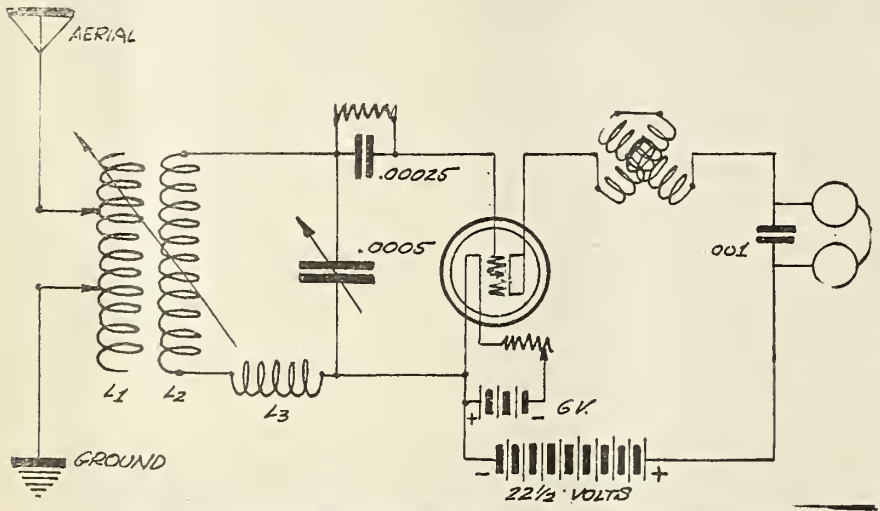

Figure 5—This is circuit used when the long distance crystal set is changed to a tube set.

These circuits are probably the simplest of any to use with the named crystal sets, and are probably just as efficient as any of the more complicated sets requiring painstaking tuning and difficult construction.

Now that you have read how to change that crystal set of yours into a real set, look over your set, select the circuit which applies, and change your set into a valve set—we are sure the change will be a worth while change—and we know it will open new doors to radio listening to the crystal user, furnishing greater entertainment and a keener appreciation of the great broadcasting institution which has proven so popular in the last two years.

**Further information may be had by referring to the June, 1923, issue. Obtainable at the regular price.*

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65,000 Letters

Since the inauguration of broadcasting by WGY, sixteen months ago, the General Electric Company has received 65,000 letters from listeners scattered over the United States and from points as widely apart as Hilo, Hawaii and London, England, Vancouver, Canada, and Valparaiso, Chile.

Some of these letters are typewritten and from the offices of business and professional men and some are penciled on scraps of paper from woodsmen and from forest rangers.

On Great Lakes

Weather bulletins and hydrographic information will be broadcasted twice daily by the Intercity Radio Company, located in Cleveland, on Lake Erie. The service is intended for the shipping on the Great Lakes, and will be broadcast on a wave length of 706 meters, spark. The call of the station is WTK. This station also is licensed to communicate with Rogers City, Mich., on a wave of 1764 meters.

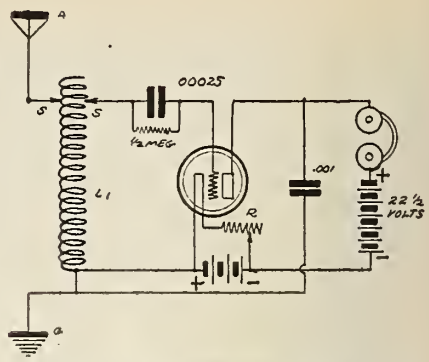

Figure 4—The two-slide tuning coil is connected to a tube much in the same way as a crystal is used.

Radio In Arctics

(*Continued from page 11.*)

tainment at any time. Two northbound ships, the S. S. "Bayeskimo" and the S S. "Nascopie" are carrying radio receiving sets to six of the posts above the Arctic circle.

In order to determine whether or not these posts will be able to hear the concerts from the United States next winter, the ships are listening in on their way north to the broadcasts as they steam to the frigid zone. Several nights ago, the Westinghouse station WBZ in Springfield, Mass., gave a special concert at 11 p. m. and radiograms received from the steamship "Bayeskimo" state that the music has been heard with great success.

There are hundreds of posts spread throughout Canada and North America, from above the Arctic Circle into James Bay. The ships have left for these trading posts and the factors will have their sets for next winter. Although the reports received so far from the ships are very encouraging, complete information on the results obtained will be obtained upon their return. The posts are so far removed from civilization that these will be the last news from the outposts until spring. The lanes of travel to these posts are entirely blocked on account of the heavy ice which accumulates.

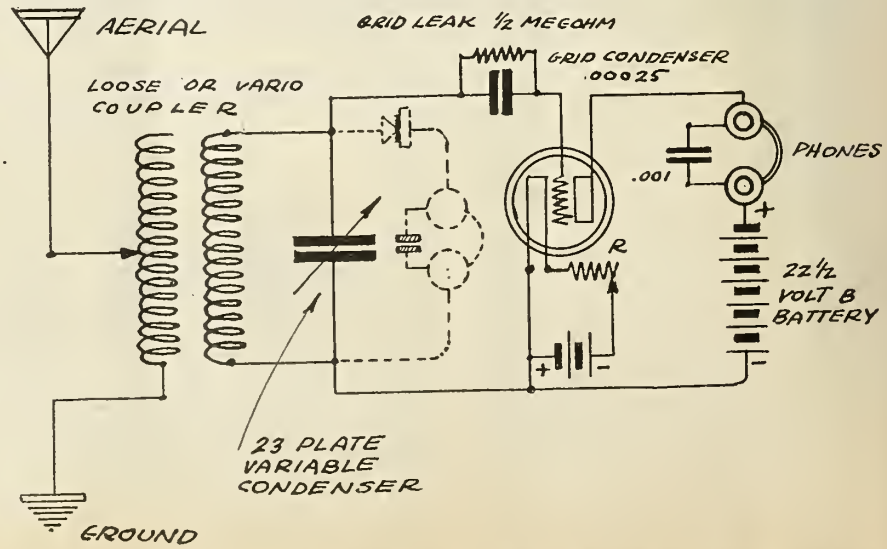

Figure 6—The dotted lines in the above circuit show the relative connections of tube and crystal in the two-circuit set.

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RADIO AGE

The Magazine of the Hour

Price 25 cents

NOVEMBER, 1923

IN THIS NUMBER

How to Make the Super-Heterodyne Set
By Frank D. Pearne
With Diagrams and Photographs

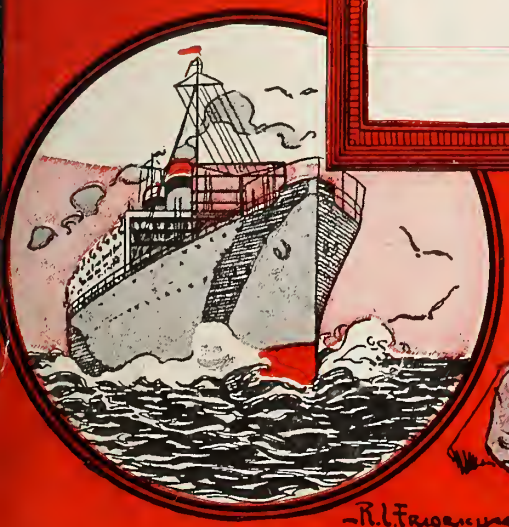
The Erla and Another Simple Tube Set

How to Learn the Code
(*First Article*)

What the Broadcasters Are Doing

Complete Corrected List of Broadcasting Stations

More Good Circuits



LET OUR HOOK-UPS BE YOUR GUIDE

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IF YOU are constructing a receiving set, a battery charger, a loading coil, a condenser, or a transformer and you need help in the way of clear diagrams and full detailed descriptions of that very thing you may have it by return mail.

We have laid aside a limited number of back numbers of Radio Age for you. Below we are listing the hook-ups and circuit diagrams to be found in these magazines. Select the ones you want, enclose 30 cents in stamps for each one desired.

We advise immediate attention to this as the stock of back numbers is diminishing rapidly.

May, 1922

—How to make a simple Crystal Set for $6.

June, 1922

—How to make a Receiving Transformer.
—Aerials under ground and under water.
—Electric light wires as auxiliary to radio.

July, 1922

—How radio sends photograph across Atlantic.
—Application of Vacuum Tube to radio.
—Marconi's radio searchlight.

September, 1922

—Bank uses radio to serve public.
—How to construct the Reinartz Receiver.
—Federal Act regulating radio.

October, 1922

—How to make a Tube Unit for $23 to $37.
—How to make an Audio Frequency Amplifying Transformer.
—Radio Frequency explained.

November, 1922

—Photo-electric Detector Tubes.
—Design of a portable short-wave radio wavemeter.
—Explanation of Radio Frequency Amplification.

December, 1922

—Home-made battery charger for $3.00.
—Principles of radio receiving equipment.

January, 1923

—How to make a sharp-tuning Crystal Detector.
—Fixed condensers in home-made receiving sets.
—Description of loading coil for simple sets.

March, 1923

—Layout and drilling for Reinartz Tuner, with amplification.
—How to make the Crystal Set do long distance work.
—Wired wireless.
—How to make an Audio Frequency amplifier.
—Symbols used in radio diagrams.

April, 1923

—The Kopprasch circuit.
—How to make a one-tube loop aerial set.
—A two-circuit Crystal Set.

May, 1923

—How to make the Erla single-tube reflex receiver.
—How to make a portable Reinartz set for summer use.
—New wave lengths.

June, 1923

—How to build the new Kaufman receiver.
—What about your antenna?
—Use of Rubber for radio parts.

July, 1923

—The Grimes inverse duplex system.
—How to read and follow symbols.
—Proper antenna for tuning.

August, 1923

—Construction of the Cockaday four-circuit tuner.
—An efficient two-stage amplifier.
—A simple buzzer transmitting set.

September, 1923

—How to load your set to receive new wave lengths.
—Simple Radio Frequency Receiver.
—Radio with the MacMillan expedition.

RADIO AGE, Inc.

500-510 North Dearborn Street, - - - - - - - - - - CHICAGO, ILL.

RADIO AGE

The Magazine of the Hour

(Established March, 1922)

Volume 2 *NOVEMBER, 1923* *Number 10*

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What's Yours?

WE HAVE a friend who lives in the Copley-Plaza Hotel in Boston. He told us recently that he had installed a super-heterodyne receiver in his apartment in the hotel and that he was getting astonishing results. He said that in spite of the fact that there was a broadcasting station in the hotel, he was able to tune it out and get the Zenith-Edgewater Beach, WJAZ, the Westinghouse KYW and other Chicago stations. And he got them loud and clear on the loud speaker. He succeeded in bringing in Los Angeles with the earphones.

"Tell your readers about the super-heterodyne," he advised.

So in this issue we have presented a rather elaborately illustrated feature on the set with ten tubes. It looks like a complicated, difficult circuit to manage but we believe the average fan will not find it so. Except for additional tubes it is not particularly more expensive to make than other sets.

We feel sure no better diagrams and photographs of the super-heterodyne have been published and we are eager to learn from readers what success they have with it. Mr. Pearne put his great ability into this article with so much enthusiasm that we feel sure there will be calls for extra copies of this issue from all over the country.

It was also brought to our attention during the last month that many receiving set owners, who are nettled at the occasional interjection of code signals into their programs of music or other entertainment, might learn the code and thus extend greatly the fun of listening in.

We are presenting in this number the first of two articles on how to learn the code. Once learned it will enable you to read private, press and government messages flitting through the night.

Who has an idea for the December number? We are adding more pages from time to time. We want to fill all of the new space with what YOU want.

One more matter. The broadcasting list changes so rapidly that it is difficult to make it perfect, even with our special Washington service. If you see errors in the list you will confer a great favor by pointing them out. For each such correction we will forward a copy of the next issue free, or, if the correction comes from a subscriber, we will add one month to his subscription period, free.

—The Editor.

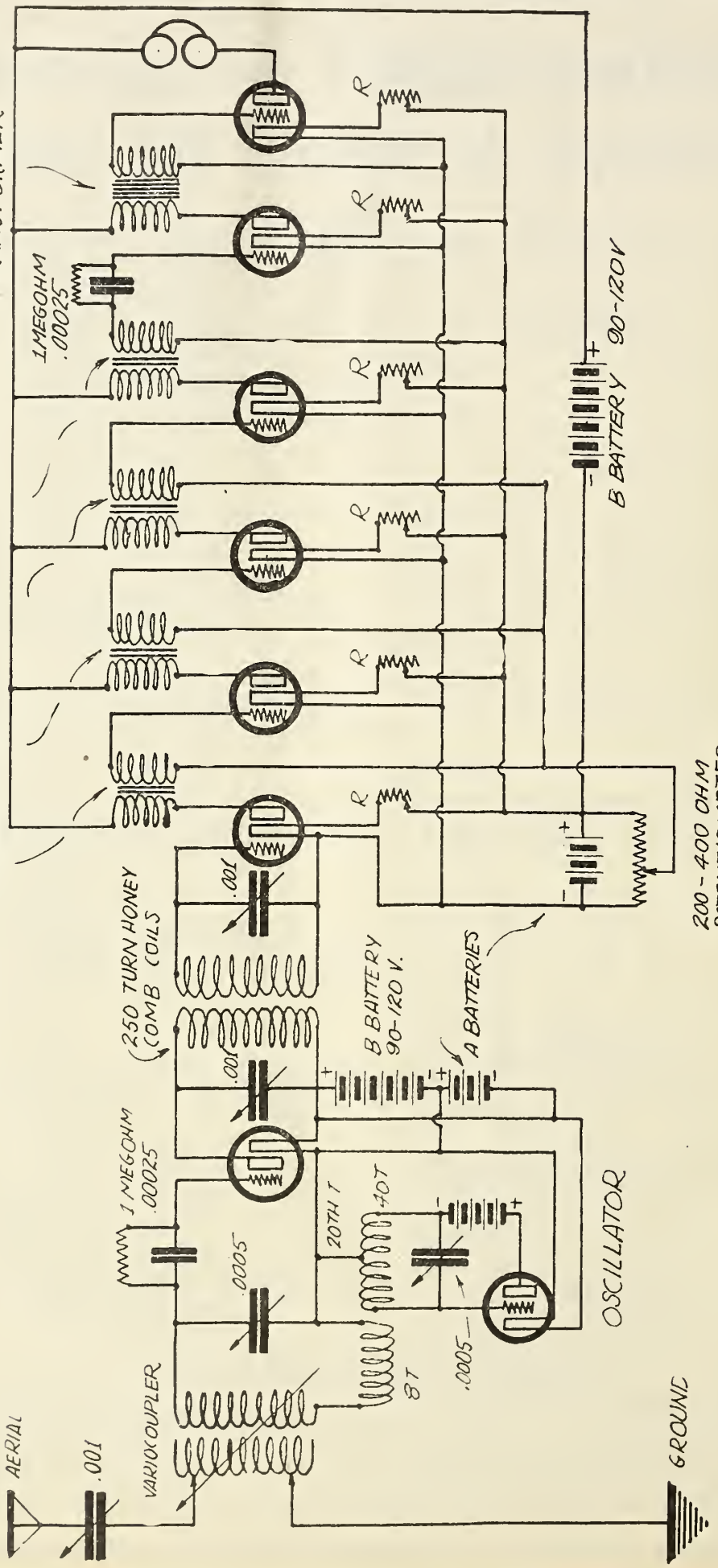


Figure 1.—Circuit diagram of the Super-Heterodyne receiver. The accompanying article by Mr. Pearne shows how this circuit is extended to a ten-tube receiver. This outfit is regarded as the most sensitive, most selective and the longest distance-maker. It is not as complicated nor as expensive as might appear at first glance.

RADIO AGE
"The Magazine of the Hour"
M. B. SMITH, PUBLISHER
PUBLISHED MONTHLY
FREDERICK SMITH, EDITOR

The Super-Heterodyne Receiver

By FRANK D. PEARNE

THE radio enthusiast of today is more interested in long distance reception than in receiving local broadcast stations. Regardless of the fact that a wonderful program may be going on at some local station, the fan gets a greater thrill out of hearing a poorly rendered musical selection from some station, a thousand miles away, and the popular idea at present is to get distance, no matter how good the local programs may be.

The most sensitive receiver known and one which will reach out farther than any other is the super-heterodyne, but because of the great number of tubes employed

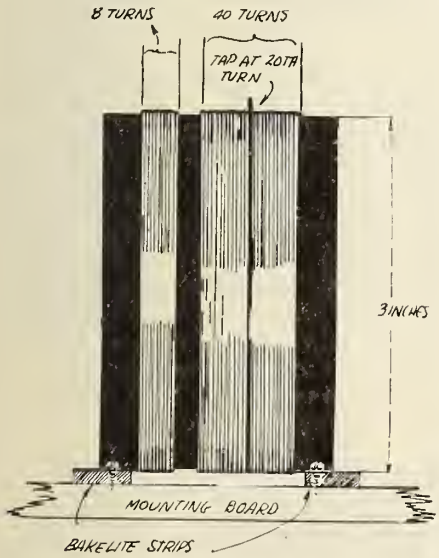


Figure 2.—Oscillator Coils.

in this circuit and the other apparatus used in conjunction with them, most amateurs balk at the expense entailed in making such a set. There are some, however, who consider the expense of a good outfit as a secondary matter and want the best, no matter what the cost may be, and after all, it is doubtful as to whether or not such a receiver is much more expensive than some of the others which can not compare with it.

Its Advantages.

Before describing the construction of the super-heterodyne, an explanation of some of the principal advantages gained over other circuits will be given. Every radio fan knows the advantage of radio frequency amplification when properly applied, but unfortunately many have tried to use it, with little or no success while on the other hand there are many who have had wonderful results with it.

In the first place every radio frequency transformer has a natural or fundamental wave length of its own and when used at this particular wave length, the efficiency of the transfer of energy from one coil to another is very high, but when waves of other frequencies are impressed upon it, the efficiency drops off rapidly, as the frequency varies farther from the natural wave length of the transformer.

Of course, there are several ways of changing this natural wave length, such as connecting a variable condenser across the terminals etc., but even then the highest efficiency is only obtained when the frequency of the incoming wave is equal to the natural frequency of the transformer. Unfortunately broadcast waves vary considerably in their wave lengths, and one station might be brought in good and strong while another of a different frequency would not come in so well.

Now by the heterodyne method, which will be explained later, the frequency of the incoming wave can be changed at will, which makes it possible to send any ordinary wave, no matter what its original length may be, through the radio frequency transformers at their highest efficiency. In other words, the waves of different lengths are all brought down to one common frequency, which is the natural frequency of the transformer. Thus all wave lengths are amplified at maximum efficiency, and without the use of any adjusting controls in the radio frequency amplifying circuit. The frequency change is accomplished without any appreciable distortion, which one might expect and all the characteristics of the original signal are preserved.

Operation.

The operation of the heterodyne is based upon the inter-action of two alternating currents of different frequencies. For example, if an oscillating current of 60,000 cycles per second is coming in on the aerial circuit and another oscillating current of 59,000 cycles per second is super-imposed on this circuit, a "beat frequency" is produced, which is equal to the difference of the two which in this case would be 1,000 cycles per second. The oscillating current which is superimposed upon the incoming current is produced by an oscillator placed inside of the receiver, which by means of a vari-

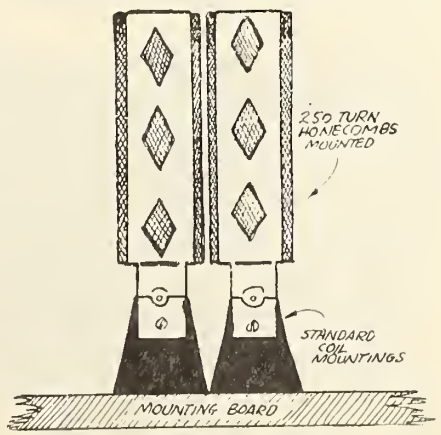


Figure 3.—Transfer Coils.

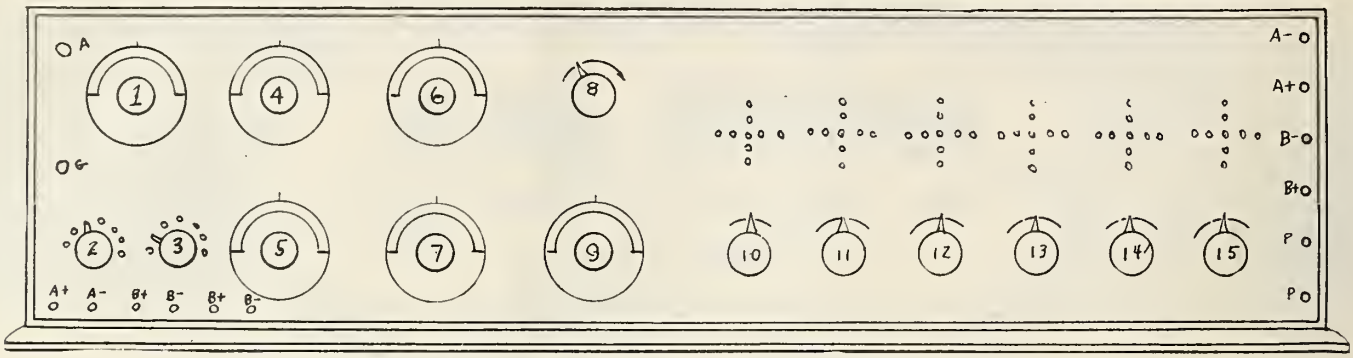


Figure 4.—Front Panel View of the Heterodyne Receiver.

able condenser may be made to oscillate at whatever frequency is desired, to produce a beat oscillation of the proper frequency to suit the radio frequency amplification component of the set.

It will be noticed that the circuit shown in Figure 1 contains two detectors and in order that the reader will not become confused, it must be stated that the first one acts merely as a frequency transformer, as its circuit contains an inductance and capacity which is tuned to the beat oscillations. This tends to suppress the high frequency leaving only the beat frequency, which is still too high to be heard in the phones, but is the correct frequency to be passed on to the radio frequency amplifiers and from there to the second detector, where it is brought down to audio frequency and passed on through the audio frequency amplifiers.

The primary inductance in Figure 1 is shown as a variocoupler. This is to be used, when it is desired to use an outside aerial, but in case a loop is preferred, the coupler is not used and the loop is inserted in place of the secondary of the coupler shown in the drawing.

The oscillator, shown in Figure 2, is made on a bakelite tube three inches in diameter. One coil of No. 20 D. C. C. wire having forty turns is wound on this and a tap is brought out at the 20th turn. At a distance of about two inches from the coil, wind another one having eight turns. This distance is required to prevent the induced current in the eight turns becoming too strong for the current in the aerial circuit, which would overpower the incoming wave if it were too close.

The energy of the "beat frequency" is transferred from the plate circuit of the first detector tube, to the radio frequency amplifiers, by two honey-comb coils of 250 turns each. These are shown in Figure 3. Because the oscillator may be so adjusted that a beat frequency of any number of cycles may be produced, the selection of the proper radio frequency transformers, as regards to wave length, becomes a very simple matter, but it has been found best to use those of a type having iron cores and wound for a wave length of 5,000 meters.

The audio frequency transformers may be of any of the standard makes, but should not have a ratio of more than 6 to 1, for the first step as shown. If a second stage of audio is added, the second transformer should have a lower ratio. 3 and ½, or 4 to 1 will do very nicely.

The potentiometer, shown in Figure 1, is used to get the proper biasing current on the grids of the radio frequency amplifying tubes. The variable condensers shunted across the terminals of the honeycomb coils should have 43 plates, giving a capacity of .001 M. F. The variable condenser used in the oscillator circuit and that which is connected across the terminals of the rotor of the coupler and the 8-turn coil of the oscillator should have 23 plates with a capacity of .0005 M. F. Three separate sets of "B" batteries should be used in this set to avoid any leakage from one part of the circuit to another.

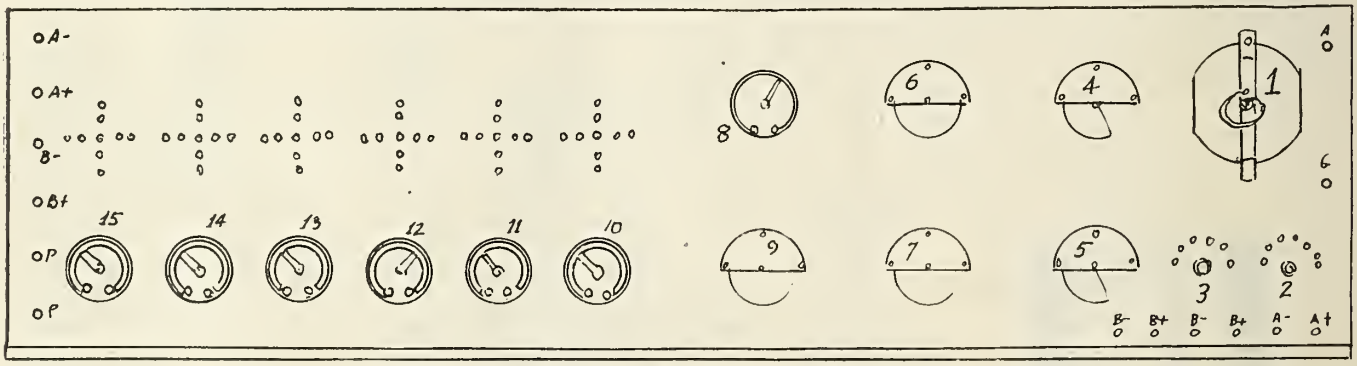


Figure 5.—Back Panel View of the Heterodyne Receiver.

Number of Tubes.

These sets usually contain ten tubes, one of which is used as an oscillator, two as detectors, five as radio frequency amplifiers and two as audio frequency amplifiers. In the set shown in Figure 1, only four are used as radio frequency amplifiers and one as an audio frequency amplifier. The balance of the tubes are used as mentioned before. If one desires to make the ten tube set, it is only necessary to insert another step of radio frequency, which will be connected like those shown, and another step of audio frequency.

Panel Arrangement.

Figure 4 shows the layout of the panel and the cabinet on the outside. No. 1 is the dial for the variocoupler; No. 4 is the aerial condenser. No. 6 is the oscillator condenser and No. 8 is the potentiometer. The other three condensers, 5, 7, and 9 are mounted below these, and the two switches controlling the taps on the primary of the coupler, are mounted directly below the coupler; 10, 11, 12, 13, 14 and 15, are the controlling knobs of the different rheostats of the five amplifying tubes and the second de-

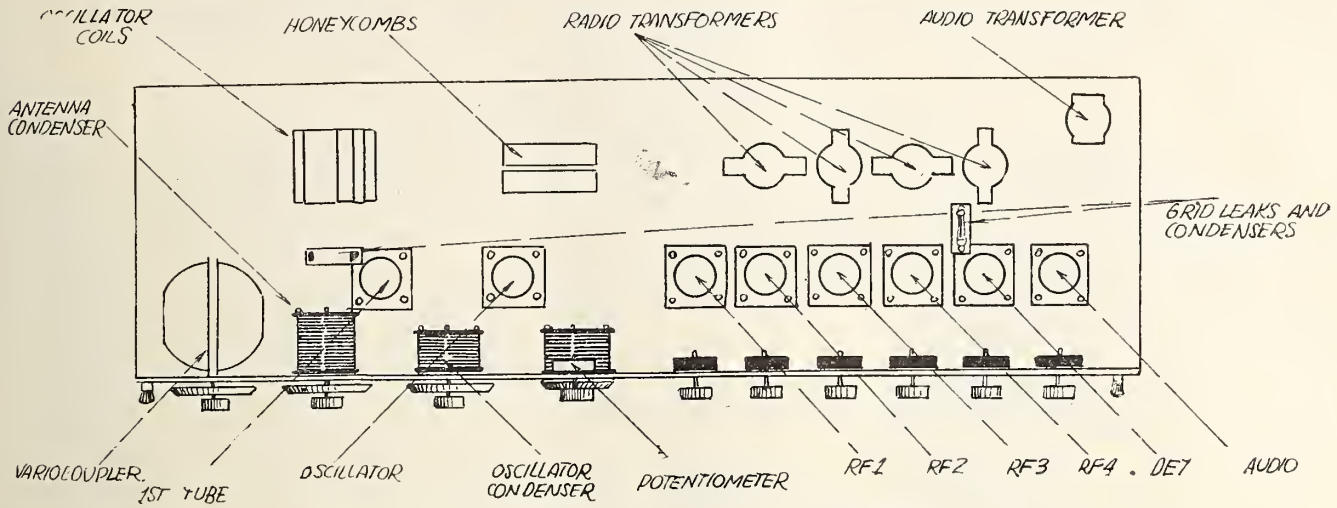
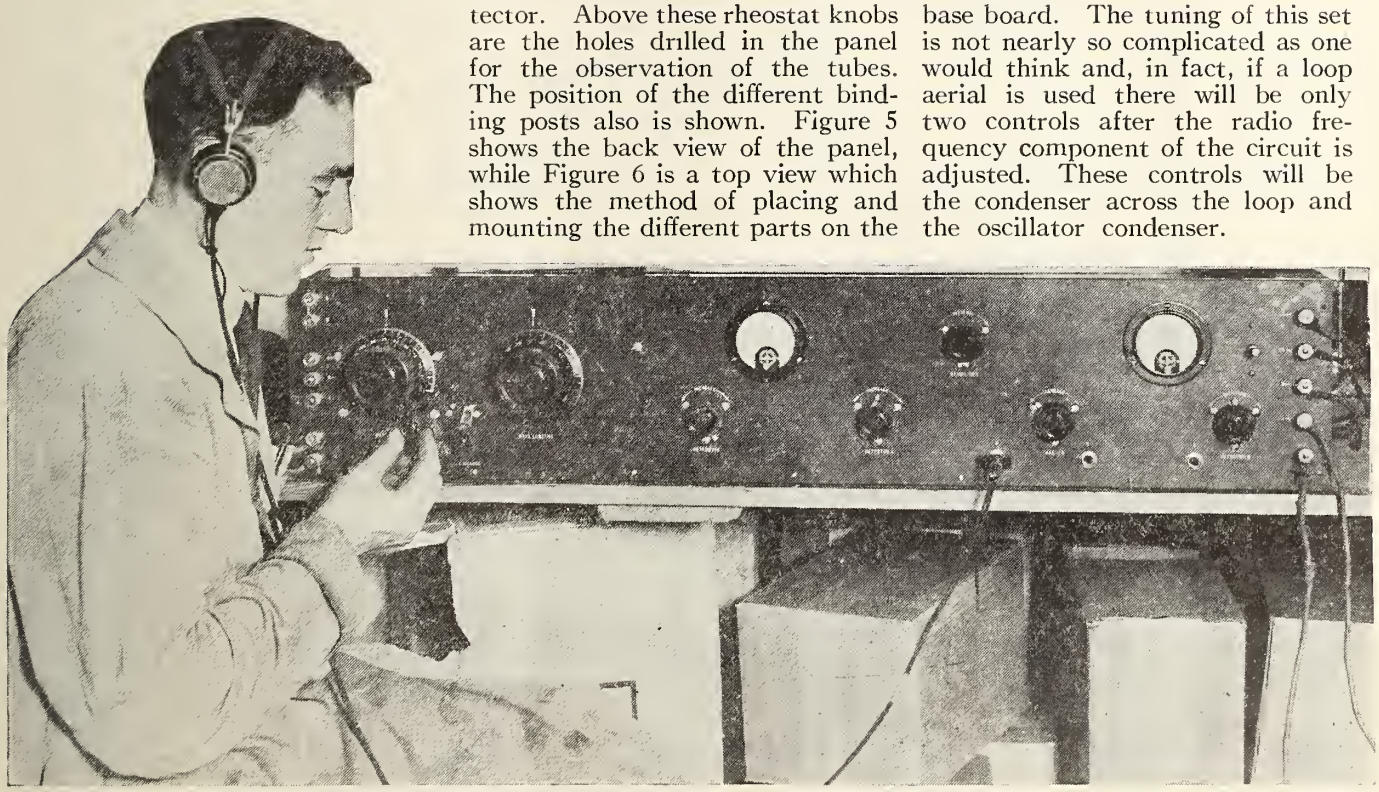


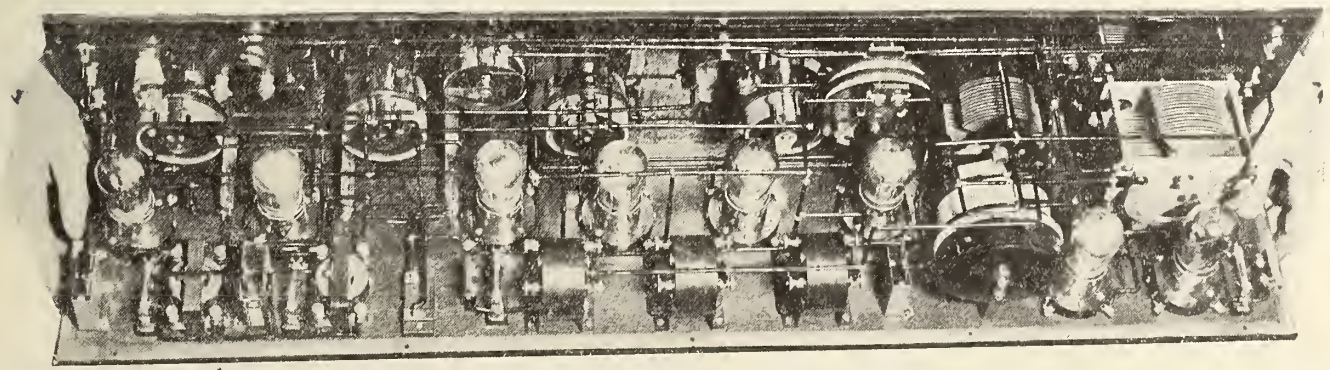
Figure 6.—Top View of the Super-Heterodyne Receiver.

tector. Above these rheostat knobs are the holes drilled in the panel for the observation of the tubes. The position of the different binding posts also is shown. Figure 5 shows the back view of the panel, while Figure 6 is a top view which shows the method of placing and mounting the different parts on the base board. The tuning of this set is not nearly so complicated as one would think and, in fact, if a loop aerial is used there will be only two controls after the radio frequency component of the circuit is adjusted. These controls will be the condenser across the loop and the oscillator condenser.

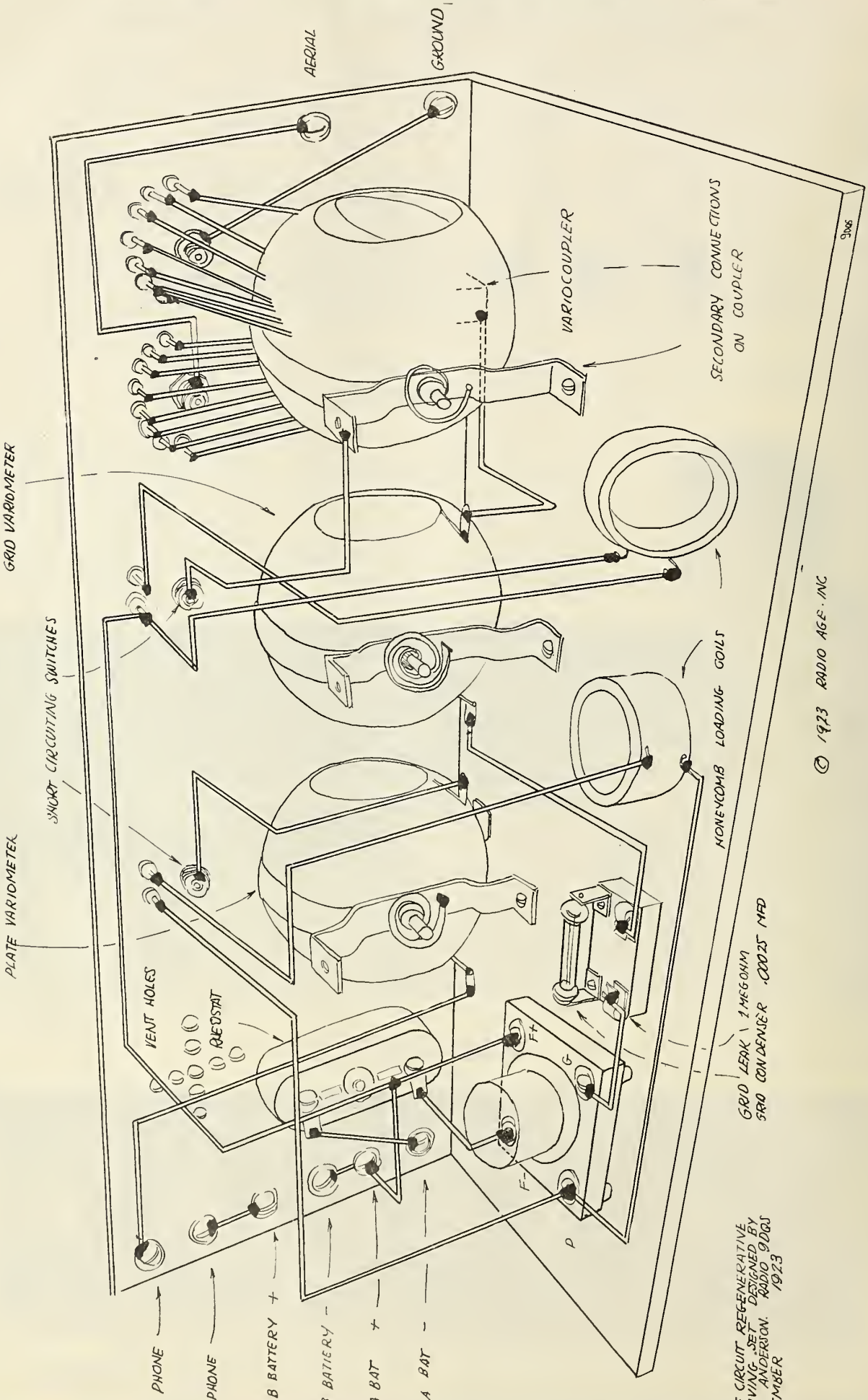


(Kadel & Herbert, Foto.)

W. K. Koellner and his super-heterodyne set, which uses only two major controls. The photograph shows the neat panel arrangement. This is an extremely sensitive receiver.



Interior of a well-built super-heterodyne receiver. This set requires only two major controls. Note neat arrangement of parts. Two of the tubes are detectors, one an oscillator, three for radio frequency and two for audio frequency. Exterior of set is shown in the other photograph on this page.



THREE CIRCUIT REGENERATIVE RECEIVING SET DESIGNED BY FELIX ANDERSON. RADIO 9 DAS NOVEMBER 1923

Construction of the Three-Circuit Tuner

By FELIX ANDERSON

WE HAVE had so many requests for information on the construction and operation of the three-circuit tuner that we are presenting herewith detailed information concerning this much talked of and efficient receiver. The three-circuit tuner sometimes called the Armstrong Circuit and also dubbed the two variometer-variocoupler circuit is an old standby which has been used for many years in amateur circles.

The reason for its great popularity is that minute changes of wave length and tuning can be effected, and for this reason it has proved a popular receiver with broadcast listeners who reside in large cities where interference from many high power broadcasting stations is always an important factor. That the set is an efficient one is demonstrated by the fact that it is the most generally used receiver among the amateurs interested in relaying code messages.

The construction of a set of this type is fortunately not difficult, and not overly expensive. The only disadvantage which seems to exist is that the set tunes so very closely that when it is placed in the hands of someone who does not appreciate the merits of a receiver which tunes as closely as this one it is classed as too difficult of operation.

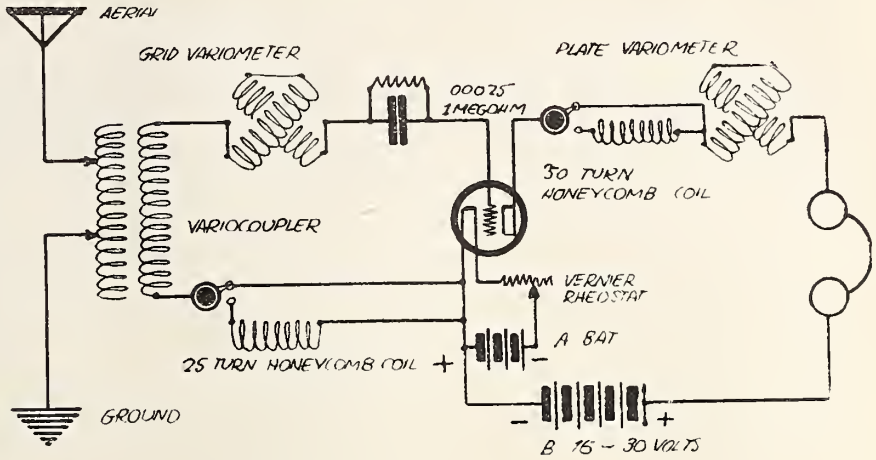
Speaking from personal experience with this circuit the writer wishes to say that he prefers it to almost any type of receiver having two or three stages of radio frequency amplification. Signals have been heard by the writer using a set similar to the one illustrated in the drawing on opposite page, from stations over three thousand miles away.

On silent nights in Chicago under favorable conditions the set brings in from twelve to fifteen stations of from five hundred to two thousand miles away, and while it is not a regular occurrence station KHJ at Los Angeles has been heard several times.

The parts required to make up a set of this type are all standard and can be purchased at your local radio store. You will need: One variocoupler; two variometers; one twenty-five turn honeycomb coil unmounted; one thirty-five turn honeycomb coil unmounted; one rheostat; four switch levers; two dozen switch points; eight binding posts; one .00025 grid condenser; one grid-leak; one megohm; one tube socket; one WD12 tube; one 22 1-2 volt B battery; one 7x15 panel; connecting wire, A battery, cabinet, phones, and antenna system and ground.

Construction

Drill holes for the various instruments, mounting them as shown in Figure 1. Space the variometers and coupler as far apart as symmetry will permit. This is done to reduce or eliminate any inductive effects which might exist between the coupler or variometers. Placing them too close together will result in howling and "mushy groans" and will cut down on the efficiency of the set.



In order to be able to tune in stations using the new wavelengths the honeycomb coils are placed in the plate and secondary circuits. The short-circuiting switches, as shown in Figures 1 and 2, cut out the loading coils when the lower waves are desired.

The isometric sketch shows variometers of the basket ball type, but any variometer of good sturdy construction can be used.

Any type of tube may be used with this circuit with equally good results.

This set works best on broadcast listening when an aerial not over one hundred feet is used. The tuning of the set is very fine and much patience and perseverance are needed before good results can be obtained; however, after the knack has once been acquired the matter of tuning is exceedingly simple. Local stations may be tuned out at will if an antenna of not over forty feet in length is used.

The three circuit set is the real set for the BCL who wants a receiver that will really tune.

Will Japan Yield?

Many radio experts feel that the terrible disaster and the severing of communication wire out of Japan will aid materially in establishing better radio service between Nippon and the world. The policy of the Japanese government has been to control radio, although American commercial companies have been endeavoring to provide better stations and transmission for some time. It is now hoped that the radio corporation will be given an opportunity to establish high-powered stations in Japan in connection with the cooperation it has already given the government toward better radio communication at less than the cable rates.

Millionaire Amateur

South Dartmouth, Mass. — After spending nearly a million dollars to build a magnificent mansion on the ancestral lands of the "Pilgrim Fathers," Colonel Edward H. R. Green, the wealthy son of Hetty Green, looked around for new worlds to conquer and hit upon radio, not as a mere pastime, but an absorbing study. An aerial 100 feet high stands out against the skyline and neighbors for miles around listen nightly to his station, "The Voice from 'Way Down East."

This is one of a series of hobbies which began for the Colonel as a boy when he started a chicken farm in Texas and ran the whole gamut from mules to fishing and politics to baseball. He introduced the first automobile and the first airplane in that state and topped off his career there when he purchased the world's largest private yacht.

Few of his friends realize, however, that Colonel Green was interested in radio before he came to Massachusetts. He was an amateur in Texas, when radio was young, and began his experiments about the time that he became a member of the American Radio Relay League. He has since maintained active concern in the welfare of amateur radio.

His other hobbies, including a houseboat, a Texas railroad and a stamp collection, are now held secondary to radio and he spends a great deal of his time riding around his beautiful estate, dotted with artificial lakes, in his electric auto, equipped with wireless.

The broadcast station, planned by Colonel Green, aided by several leading engineers of the country, is a well-furnished home itself, with a reception room. His programs are of the best, since they are sent from New York by wire, and as the evening breeze blows in from the shore, hundreds listen to what they call the colonel's "jazz fog.'

How to Detect a Bootleg Tube

THE WIDE use of the UV-199 has led to numerous attempts on the part of unscrupulous manufacturers to counterfeit this tube. In external appearance some of the imitations bear such a close resemblance to the genuine tube that it is very difficult to detect the difference. Even the carton markings, the instruction sheets, and the trademarks etched on the tube itself have been copied very closely.

However, in spite of the resemblance in appearance, the electrical characteristics of the counterfeit tubes are very different from those of the genuine UV-199. So far, none of the manufacturers of the illegal tube has been able to duplicate the sixty milliampere filament of the UV-199 and most of the counterfeits require as much as one fourth of an ampere. Since the voltage of this filament can easily be made 3.0 volts, or less, the user of such a tube is often misled by the apparently satisfactory operation when the tube is first lighted, but he soon finds that his dry battery is quickly exhausted and often the tube itself fails in a few hours.

Of course, the easiest way of determining the current required by the filament is to use a milliameter and voltmeter, but since such instruments are not in common use among radio experimenters another simple method described below may be used which gives a rough approximation of the filament current.

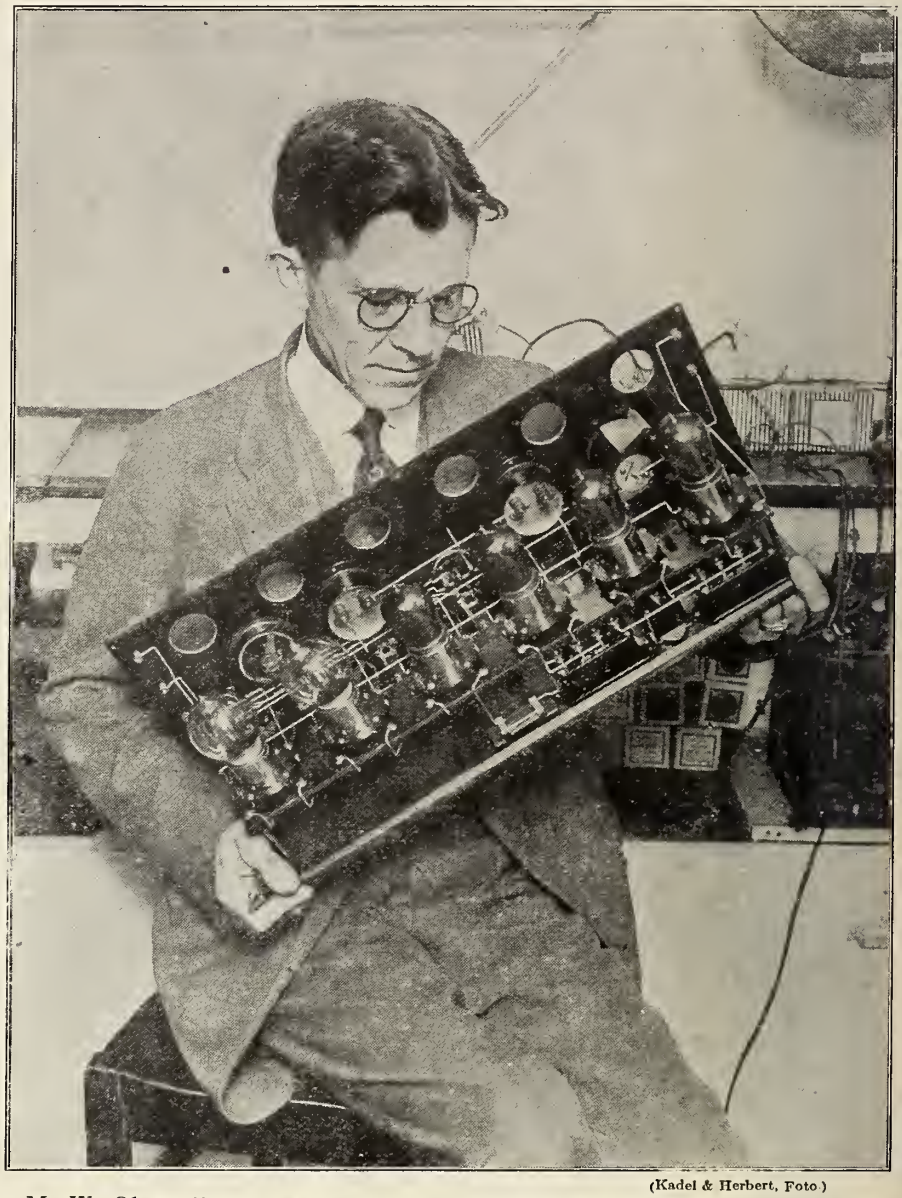
Connect three new six inch dry cells in series with the tube to be tested and an ordinary fifty-watt, 110-120 volt Mazda vacuum lamp. Figure 1 shows the proper connections. If the filament of the tube being tested does not take more than sixty milliamperes, it will light up almost to normal temperature. But, if the tube is not a genuine UV-199 and the filament requires appreciably more than sixty milliamperes, the resistance of the Mazda lamp will rise due to the higher current flowing through it, and the voltage on the tube will be so low that its filament will not light. In making the test, be sure that the tube is left in the socket for about thirty seconds to allow the Mazda lamp filament to heat up to constant temperature.

When the proper electrical instruments are available, an even better test is to use a voltmeter and milliameter connected exactly, as shown in Figure 2.

At three volts the current through the filament of a genuine UV-199 Radiotron lies between fifty-five and sixty-five milliamperes.

For this test high quality instruments must be used, otherwise this test is worthless.

A voltmeter having a full scale reading of five is recommended. For the milliameter use an instrument having a full scale reading somewhere between 100 and 250 milliamperes.



(Kadel & Herbert, Foto.)

M. W. Obermiller's receiver picks up distant stations with a loop aerial. It utilizes two stages of audio frequency and three of radio frequency, with but one control. The tonal quality achieved with this set is exceptionally good.

Steals $1,500 Station

Rolla, Mo.—Radio thieves are active here.

The disappearance from this town of the entire apparatus at the amateur station, operated by S. P. Stocking of 610 State Street, and licensed by the government under the call 9AZH, has resulted in a statewide search by local police authorities, while circulars describing the equipment in detail have been sent all over the country.

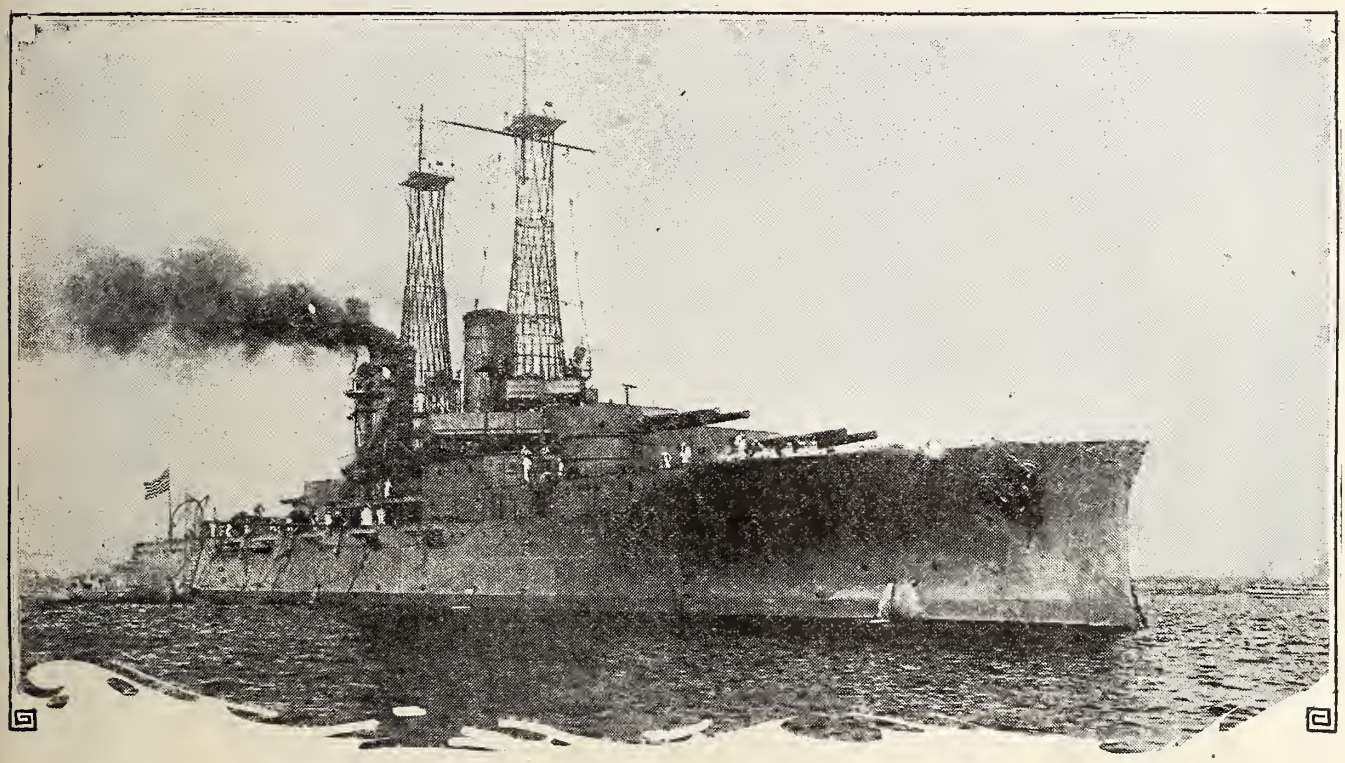
In two successive visits, probably planned by the same conspirators, every piece of this privately owned set, from a pair of lightweight phones to a 100-watt transmitter, valued in all at nearly $1,500, has vanished into the night. Stocking is a member of the American Radio Relay League and has asked fellow amateurs to aid him in recovering any part of the missing radio station.

Evidently the time has now come, Mr. Stocking believes, when a radio station is as difficult a thing to keep as an automobile and the thief, who has been bitten by the radio bug, is equally annoying as the joyrider who picks up a stray car and abandons it on a deserted country road. The difference is that the radio thief carries his work further, believing that "findings is keepings."

The new owner of station 9AZH may already be on the air, but if the truth be known, his presence is not welcome.

Of course 9AZH's parts may be scattered far and wide, dribbled away among secondhand dealers at half the value, but the assumption is that the thief or thieves knew the game and set a much higher price upon the set, which is that of "ownership."

Radio Will Guide $7,246,687 Ship to Destruction



WASHINGTON, D. C.—The next radio-controlled ship of the Navy will be the old battleship, "North Dakota," authorized in 1907 and commissioned in 1910, but designated to be scrapped by the Arms Conference. A lack of available funds for the radio-control equipment will prevent the execution this year of the navy's plan to carry out extensive gun-fire and aerial bombardment with this ex-first-line ship as moving target. She will be de-commissioned and much of her armament and equipment salvaged in anticipation of equipping her with radio control apparatus next year. In the meantime, she will be kept in good condition at her present berth at the Norfolk navy yard.

"How can the navy afford to sink a vessel whose hull, armor and machinery alone cost $7,246,687, and whose radio equipment will cost $100,000 more, at least"? some critics will ask. In the first place, she is useless as a fighting craft, but the answer lies in the results of the aerial bombing and the gun-fire experiments with the old "Iowa," now at rest in Panama Bay.

She was the navy's first radio-controlled target ship, and the only full-sized ocean-going craft ever operated by radio without men aboard. From her, naval radio engineers learned how to control a vessel from a distance; the aviators learned how to bomb moving targets, while the range-finders and gunners experienced for the first time long range and even indirect fire at a real battleship while under way. Designers and ordnance experts also gathered valuable data.

Improvement in all lines of the service was noted; hence a second ship is to be radio equipped, when sufficient funds are appropriated. She must be sunk or disposed of eventually, but with special shells and bombs, it is planned to keep her afloat as long as possible when the final maneuvers start.

The "North Dakota" will have radio control equipment similar to that on the old "Iowa," sunk last winter. The equipment will enable her to proceed at a higher rate of speed, approximating fifteen knots, it is understood. Radio control will provide for increasing her speed to maximum from a low initial speed and stopping her. The speed cannot be varied, but she can be maneuvered right and left by her radio rudder control from her operating ship several miles away.

The new radio equipment will cost $100,000, it is estimated, although no definite figures have as yet been prepared. The total cost of partly scrapping, that is removing guns, etc., will also cost another $100,000, but this amount would be entailed through the armament agreement.

Captain Chauncey Shackford is chairman of a special naval board, appointed by Secretary Denby, to prepare plans for the conversion of this vessel into a radio controlled target ship and outline a program of tests.

Talking to MacMillan

(Special to Radio Age)

Prince Rupert, B. C., Oct. 15.—Hawaii has established radio contact with the North Pole; the Arctic seas, swept by icebergs, and the sunny shores of the tropical Pacific islands have met through the ether, according to messages received here from the exploration party in charge of Captain Donald B. MacMillan, by Jack Barnsley, operator of a local amateur station and member of the American Radio Relay League.

Safe in winter quarters at Refuge Harbor, about ten miles north of Etah, Greenland, Donald H. Mix, radio operator for WNP, Wireless North Pole, has sent a number of personal messages from the Bowdoin's crew to relatives at home advising the safety of all hands.

For several nights in succession the North Pole has come in at the local station clear and strong and finally, when atmospheric conditions were unusually favorable, a five hundred word press message giving full details of exploration progress.

Although he has himself been bound in the silence of the North, unable to push down in Hawaii, which is the extreme opposite in temperature, have been heard at the Pole, according to Mix, who sent a radiogram to the operator of that station, through Barnsley, that his transmitter was heard plainly while in communication with amateur radio station 6ARB.

With all the power available through his two fifty-watt tubes and sticking by his set until early morning, Barnsley has been forwarding nightly messages to and from the Arctic schooner, several of which, destined to various points of the United States, have been delivered already via the American Radio Relay League system.

Mr. Barnsley has been advised through the A. R. R. L. Headquarters at Hartford, Conn., that he is the winner of the Zenith receiver and amplifier, offered by the Chicago Radio Laboratory to the first amateur to receive a press message from Wireless North Pole.

Broadcasting in Sweden

"Svenska Rundradioaktiebolaget" is the name of a new firm in Sweden for broadcasting. The organizers of the company are Elektriska Aktiebolaget, A. E. G., Allmanna Telefonaktiebolaget, L. M. Ericsson and others. The minimum capital of the company has been fixed at 100,000 kroners and the maximum at 300,000 kroners. The company has applied to the government for a concession to transmit information by radio.

Appointed Chairman

E. B. Mallory, manager of the Radio Sales Department of the Westinghouse Electric and Manufacturing Company, who is located in New York City, has accepted the invitation to be chairman of the Radio Communication Committee of the American Marine Congress, which will be held in New York City, November 5 to 10, inclusive. The congress will be held in connection with the American Marine Exposition.

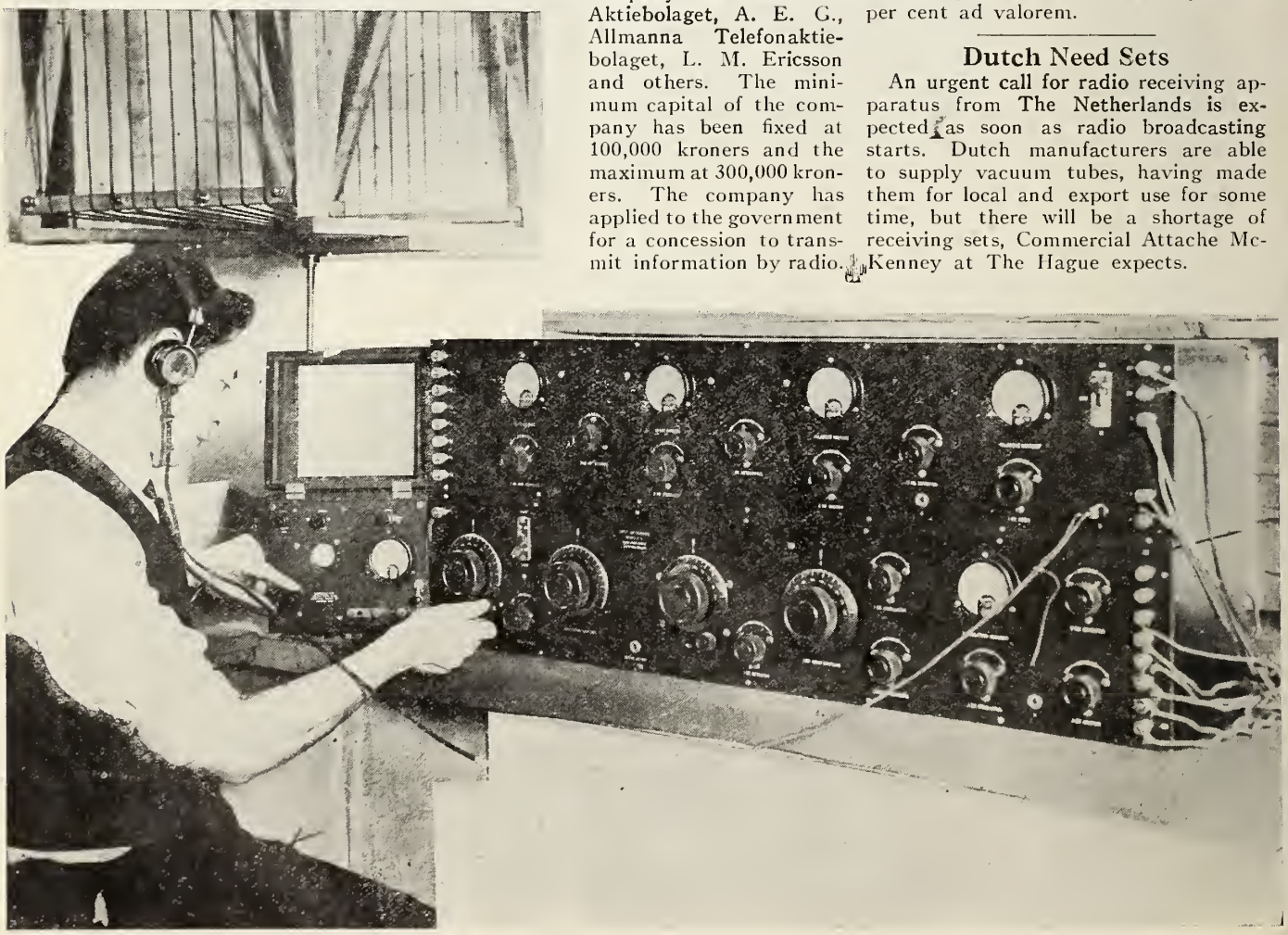
Mr. Mallory is now chairman of the radio section of the Associated Manufacturers of Electrical Apparatus.

Duty Reduced

The import duty on apparatus for wireless telegraphs imported into British India has been reduced to not more than two and one-half per cent ad valorem. The former rates of import duty on telegraph instruments and apparatus and parts thereof were fifteen per cent ad valorem except if imported by, or under the orders of, a railway company, when they were subject to a duty of ten per cent ad valorem.

Dutch Need Sets

An urgent call for radio receiving apparatus from The Netherlands is expected as soon as radio broadcasting starts. Dutch manufacturers are able to supply vacuum tubes, having made them for local and export use for some time, but there will be a shortage of receiving sets, Commercial Attache McKenney at The Hague expects.



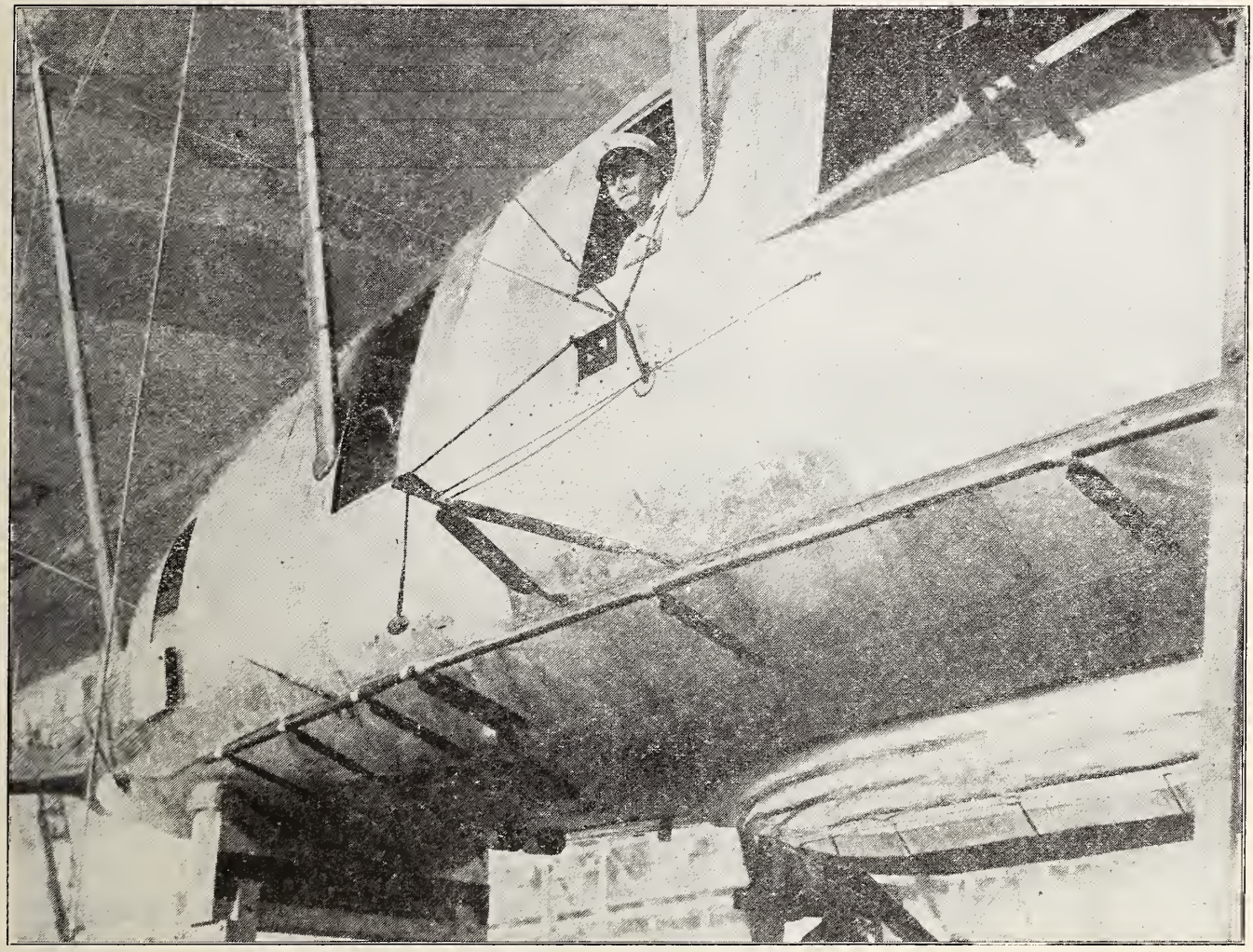
(Kadel & Herbert, Foto.)

Claude Golden, builder of this fourteen-tube super-heterodyne receiver, suspects it is the most sensitive radio receiver in existence. It picks up Pacific Coast and European signals. It uses a specially constructed loop aerial, a portion of which may be seen at the upper left of the picture. Photograph gives good idea of arrangement of controls and adjustments. For selectivity the super-heterodyne has never been equalled.

signals from his powerful transmitter past the radio absorbing curtain of the aurora, Mix has successfully heard amateur stations in all of the nine United States districts.

The signals of amateur station, 6CFU,

KWY Broadcasts Route of Airship



The East and Middle West recently were thrilled by a glimpse of the giant U. S. navy dirigible airship, ZR-1, which sailed from Lakehurst, N. J., to St. Louis and thence to Chicago and return to Lakehurst, in two days. In the gondola of the great craft, shown in the above photograph, was installed a radio outfit with which communication was maintained with headquarters on the Jersey coast. Note the lead-in insulator and the V-shaped frame that supports the antenna. The antenna consists of a hundred feet or more of wire, which is pulled down by a weight and dangles like a pendulum. Man looking from window (or is it a porthole?) is John T. Robertson, radio operator in charge.

WHEN the giant navy dirigible, ZR-1, nosed her way out of a bank of clouds within sight of her home hangar at Lakehurst, N. J., on the morning of October 3, she had completed a record trip to St. Louis and return, consuming forty-seven hours and forty-nine minutes. The ship covered approximately 2,200 miles during forty-six hours actually in the air.

As great an achievement as this trip proved in many respects, among the most remarkable features in connection with it was the radio—this in itself was noteworthy. Radio practically replaced wireless which heretofore was the only means by which airships could keep in touch with terra firma.

When the flight started from Lakehurst, N. J., station KDKA of the Westinghouse Electric & Manufacturing Company, located at East Pittsburgh, kept in touch with its progress. Arrangements had been made with correspondents in the different cities over which the dirigible passed to report by radio its movements. After the ZR-1 left St. Louis, Westinghouse Station KYW, at Chicago, followed its movements and gave a report over radio from its station every fifteen minutes.

Radio fans were advised approximately about the time when it would pass in their vicinity and were asked to keep in touch with KYW and let the announcer know as soon as they sighted the dirigible. This request was met with numerous phone calls and telegrams from many points along its route enabling thousands to keep in touch with its movements so that they could watch its flight.

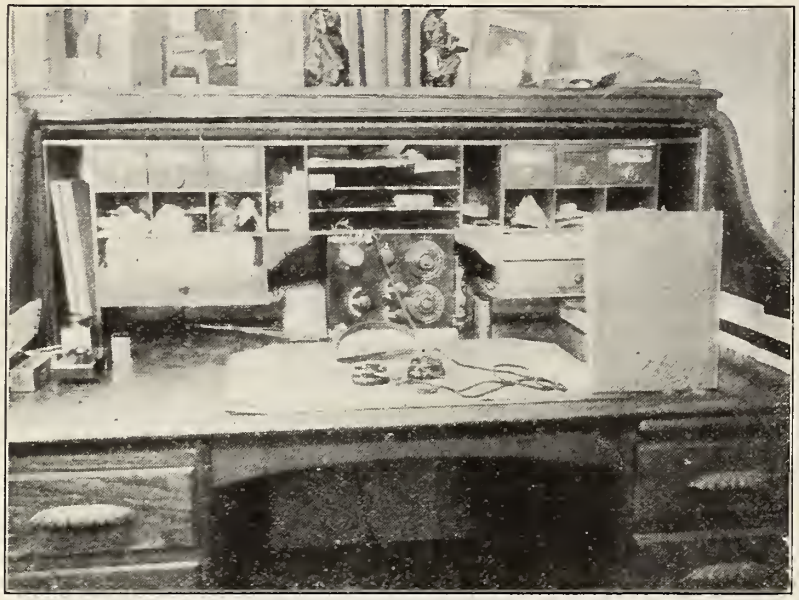
Army Station

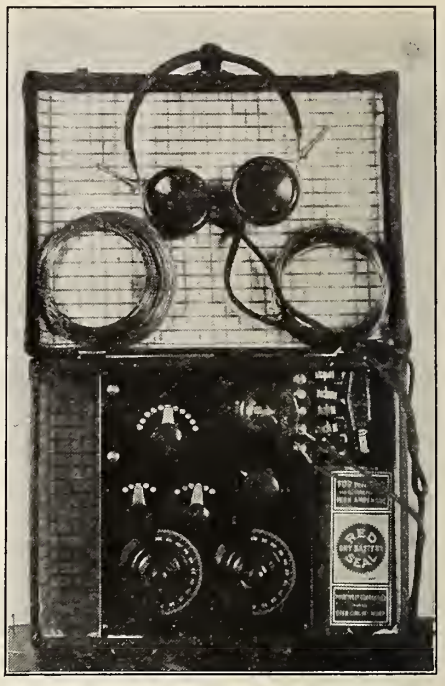
The first of November witnessed the inauguration of the big new Army Signal Corps, radio station at Fort Douglas, near Salt Lake City, Utah. This is the largest radio telegraph station of the army; it has but one tube but that is a water-cooled ten kilowatt tube. The General Electric Company built this equipment.

Another similar station is being erected at Leavenworth, Kan., by the Western Electric Company, but this station will operate with two tubes and will have a telephone circuit as well as the radio telegraph. The radio circuit between these two stations, the Arlington, Va., station, and a land line from Leavenworth to San Francisco, will span the United States. Each of the two interior stations will be equipped with two steel 300-foot towers.

It is the plan of the army radio service not to use coastal stations, that part of the work being handled by the Naval Communication Service, and the army does not desire to interfere with ship to shore communication.

What Becomes of the Portable Reinartz in Winter?





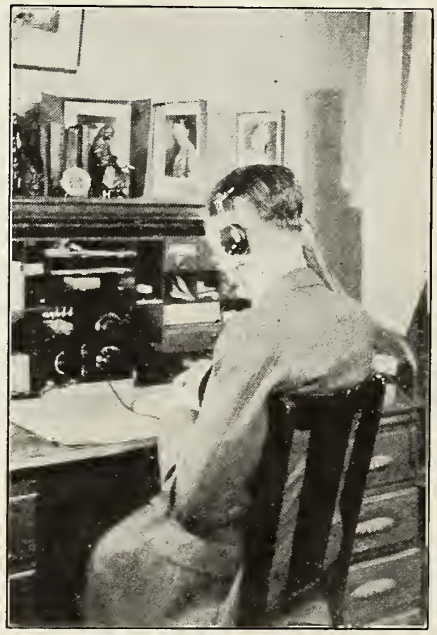
Last May, RADIO AGE printed instructions relative to the construction of a vacation outfit, embodying the Reinartz circuit, and it gives us great pleasure to learn that the set has proven a worth while undertaking as far as its use during outings and vacations are concerned.

Joseph Budlong of 2406 Foster Avenue, Chicago, is the proud owner of one of these handy portable Reinartz receivers, and writes us that the set not only demonstrated its worth during his summer vacation, but also has made itself more valuable inasmuch as its compactness and small size enabled him to remodel it into a household radio set with a minimum amount of trouble.

He tells us that its size just suggested placing it into his desk in one of the compartments, and he found on trial that the idea worked admirably. The set was removed from the grip used to make it portable as shown in the accompanying photo, and was placed in one of the compartments of the desk. The batteries and all unsightly wires were brought into the set through the back of the desk, and only the controls, and phones are visible to the operator. When he intends to make another extended trip where radio would be entertaining, all that is necessary to do is to remove the set and batteries from the desk compartment and place it into the grip and whisk away.

To testify as to the efficiency of the set, he enclosed the following list of stations heard during his spare moments in September:

WGY, KDKA, WSAI, WLW, WDAF, WOS, WTAS, WCBD, KSD and all local stations.



"What Becomes of the Portable Reinartz Set in Winter?"

At top, left, the portable Reinartz set adjusted into a roll-top desk. At right, top, the set as it was used during the summer. Below, Mr. Budlong using his Summer set at his Winter headquarters.

Needs Radio Operators

Radio operators seeking employment will find excellent opportunities this fall for real radio work on board ships of the United States Shipping Board, which sail the seven seas and call at every port in the world.

The annual turnover of radio personnel is large, due to several causes, among them being the fact that many college men spend their summer vacations sailing the briny deep as marine radio operators, and then return to their studies at the end of the vacation season.

It is understood that approximately 100 first class radio operators can be placed on government vessels alone during the next few months.

On the first of last July, the government increased the pay of all its commercial operators approximately fifteen per cent. The monthly rates of pay now in effect range from $85 a month to $125. A few positions pay a higher salary.

Radio operators aboard Shipping Board ships are classed as officers and, in addition to their regular monthly pay, receive free lodging, meals and such other accommodations as are accorded to ships' officers.

Applicants for berths as radio operators must hold commercial first class radio operators' licenses, which are issued by the Department of Commerce. Examinations for such licenses may be taken any time at the offices of the Department of Commerce's Radio Supervisors, located at the following places: Custom House, Boston, Mass.; Custom House, Baltimore; Custom House, New Orleans; L. C. Smith Building, Seattle, Wash.; Custom House, New York; Federal Building, Atlanta, Ga.; Custom House, San Francisco, Calif.; Federal Bldg., Detroit, Mich.; and Federal Building, Chicago, Ill.

Radio operators who desire employment on board Shipping Board vessels and holding required licenses should communicate with the radio companies which employ operators for the Board. These companies are: Radio Corporation of America, Ship Owners Radio Service, Inc., and Independent Wireless Telegraph Company, all of which have offices in large American ports.

What the Broadcasters are Doing

(News for this department is solicited from all stations)

Willard Station

The most powerful radio broadcasting station in the world relying exclusively on storage battery power is WTAM, the large new broadcasting station of the Willard Storage Battery Company, of Cleveland. It is on a wave length of 390 meters.

WTAM has installed a 1,000 watt transmitter, making it one of a very few with such high wattage. WYG at Schenectady, heard all the way around the world, is transmitting with 1,000 watts.

The new station has been erected on a large lot adjoining the immense Willard plant. A substantial building to house the station provides separate rooms for the transmitting equipment, storage batteries, reception parlor and studio, with commodious dressing rooms for the artists who will entertain the invisible audiences.

The outstanding and unique feature of the Willard station is that it not only has 1,000 watts for transmitting but that storage batteries, which have for some time been recognized as the ideal source of power for clear and steady transmission, are being used exclusively. Huge racks of storage cells provide the 2,500 volts required by the 1,000 watt transmitter.

The station has been so planned and built that no moving machinery is in or near the station. Even the machinery for control of ventilation and heating is remotely situated from the building.

An unusual form of aerial is employed, specially designed to eliminate static interference. The antenna consists of twelve wires in a double cage of six wires each. This aerial has a span of 100 feet, with a weight of approximately 300 pounds. It is suspended at a height of about 138 feet between the two 140 foot towers. The giant towers are constructed of four inch angle iron to a height of 112 feet, the remaining distance being covered by thirty-eight foot masts of wood. Stranded steel guys, with numerous strain insultors, are set into concrete piers for back bracing, and the legs of the towers are deeply seated in more massive piers of concrete.

A counterpoise, sixty feet wide and 250 feet long, is supported by twelve inch I beams, twelve feet tall, immediately beneath the spread of the aerial. This counterpoise is composed of twelve 250 foot lengths of antenna wire spaced five feet apart.

Cleveland's best entertainers are already listed for this station. Programs are to be broadcast on Wednesday and Saturday evenings of each week, starting at 8:00 p. m., eastern standard time.

New Bible on Air

Station KYW, Westinghouse, Chicago, is broadcasting the popularized version of the New Testament, an American translation by Professor Edgar J. Goodspeed, of the University of Chicago. The reading is conducted from 6:30 to 6:35 o'clock each Sunday evening.

Arrangement for broadcasting this modern translation of the New Testament was made with Dr. Goodspeed and the Chicago Evening Post, which controls the Chicago newspaper rights of the Goodspeed version.

The New Testament, an American translation, is a new translation of the New Testament in the language of today. It is a dignified, scholarly version that retains the vigor, ease and clarity of the original Greek—a reverent translation that removes the stumbling block of a vocabulary centuries old. It has been designed not only to tell Americans what the ancient writers say, but to make it easy and pleasurable for modern readers to turn to the greatest book in all literature.

Since Westinghouse station KYW has been in operation, which will be two years in November, the program managers have attempted to develop an extensive schedule of church services mainly for the benefit of those persons of the invisible audience who are shut-ins and otherwise incapable of attending the services at their neighboring churches.

This schedule is now complete with the station broadcasting two separate services each Sunday. The first of these is the program of the Central Church, which is broadcast from Orchestra Hall, Chicago, beginning at 11 o'clock in the morning.

Each Sunday night the services of

(Kadel & Herbert, Foto

WOR, Newark, N. J., has been making a lot of friends. One of the reasons, in addition to the excellent station equipment, is the announcer, Joseph Barnett, whose portrait appears herewith, smiling into the microphone.

the Chicago Sunday Evening Club, which are held in the same place, are sent by way of the ether. This is accomplished by a special sealed telephone wire connecting the hall with the station. Now, in addition to these two features, the introduction of the reading of the New Testament will be welcomed by radio listeners who are devoted churchgoers.

Sunday Night Music

The WGY Symphony Orchestra, reorganized for the season of 1923-24, gave the first of a series of five weekly concerts to be broadcast by WGY, the General Electric Company radio station, Sunday afternoon, October 14. Leo Kliwen, director last season, will again direct the orchestra of twenty-five men. Guest directors will be invited to take charge during the series of concerts.

Arrangements have been made with the management of the State Theatre in Schenectady, N. Y., to have the concerts in the large auditorium of his theatre. Pick-up devices, or microphones, gather in the sound waves and the theatre is connected to the transmitting equipment of WGY by telephone lines. The listeners not only hear the music but also share in the applause which follows the numbers.

The concerts by the WGY Symphony Orchestra last spring proved very popular with the radio fans and the continuance of the work of this organization is prompted by the many requests which have been received for a first class Sunday musical program.

Mexican Band at WJAZ

The Zenith-Edgewater Beach Hotel broadcasting station, Chicago, on the evening of Sunday, September 30, gave to its listening audience throughout the United States a rare treat which was fully appreciated as is evidenced by the thousands of letters pouring in to the station. The Official Mexican police band of eighty-seven pieces, sent to this country by President Obregon, appeared in full uniform and rendered a concert of continuous playing, lasting over one and one-half hours. Many of this band stood during the entire time, and there was no intermission. When the director of the band was asked if they did not desire an intermission, his reply was, "Oh, an hour and a half of straight playing is nothing. In Mexico we often play steadily for three hours."

This band came to the United States on the heels of the recent recognition of Mexico as a friendly handclasp from President Obregon. To put it in the words of the Mexican Consul: "We can express our appreciation most appropriately through music." The Mexican Consul stated this was the first appearance of this band at any radio broadcasting station.

The band was organized twenty years ago by Velino M. Preza, who still is conductor and has seen it grow not only in the affections of the Mexican people, but in the esteem of foreigners, and especially of the highest musical critics.

In 1908, when President Diaz met Mr. Taft, then President, in conference on the Mexican border, this band furnished the musical setting, and President Taft personally expressed his appreciation and extended his felicitations to the conductor.

It is a symphony band, and every member is a Mexican and a musical expert. The requirements for admission are extremely rigid. The youngest member is twenty-two and the oldest sixty-five. There are no string instruments in the band other than two bass viols. There are twenty clarinets, ten cornets, six saxophones, etc., etc. An extremely difficult combination to put over the radio, and preparations were in progress five days to properly stage and reproduce this band from station WJAZ.

The name of this band is somewhat of a misnomer and would indicate a relation with the police force, but in reality all members are accomplished civilian musicians.

This mark of friendliness on the part of President Obregon in sending to the United States this wonderful band has cost the Mexican government approximately $100,000.

On Sunday evening, directly in front of the band in the Marine dining room of the Edgewater Beach Hotel, were seated as guests of the hotel at dinner the Mexican Consul in the seat of honor and the consuls representing the following countries: Great Britain, Argentine, Columbia, Cuba, Czecho Slovakia, Denmark, France, Germany, Japan, Netherlands, Spain, Sweden, Uruguay. The counsuls' table was decorated with the flags of the various nations there represented.

Fooling the Cat

IT MAY be possible, soon, to turn over a few household tasks to radio broadcasting stations. For example, it is conceivable that the cat may be put out at night by an order delivered at a given hour by a radio broadcasting station.

WGY, the Schenectady station of the General Electric Company, recently broadcast a "Farmers' Program." The numerous numbers were introduced as part of a celebration of the fiftieth wedding anniversary of Josh Quinby and his wife, Samanthy. The announcements were all informal and instead of signing off in the usual formal manner "Josh," after speeding the departing guests, called to the cat preparatory to locking the kitchen door and blowing out the lights. His call "kitty, kitty, kitty" was carried to a great many homes with the following result as related in two letters received by WGY:

"To convince you how perfectly we received your program," wrote Mollie Chesbrough, of Addison, N. Y., "I will tell you that out pet kitty was lying on the sofa asleep. When the bridegroom of fifty years ago was calling kitty to put her out, our kitty immediately got up to see who was calling him and for two or three minutes did not remove his gaze from the magnavox."

Charles J. Chase, who runs the general store at Sebec Station, Maine, writes: "Our cat heard you call and knew it was bedtime and hid away and did not want to be put out."

New Denver Station

Denver, Colorado, has been selected as the site of a powerful radio broadcasting station by the General Electric Company, according to an announcement made recently by Martin P. Rice, director of broadcasting for that company. Work on the new station will be started as soon as the General Electric Company station at Oakland, California, is finished, probably in December.

Denver will have the third and last station in the General Electric program of broadcasting stations. The first, WGY, at Schenectady, has been in operation for the past eighteen months. Oakland, the second station, is the first to be housed in a structure erected exclusively for broadcasting equipment.

Both the Oakland and Denver stations will be modeled after WGY, so far as equipment is concerned. They will have the same power and sending radius as WGY which, under favorable atmospheric conditions, has been heard on a single transmission in every state in the union, in England, Hawaii and countries of South America.

McDonald Elected

The first annual convention of the National Association of Broadcasters was held in New York and on October 12 the following officers were elected:

President, Eugene F. McDonald, Jr., of the Zenith-Edgewater Beach station WJAZ, Chicago.

First vice president, Frank W. Elliott, WOC, Davenport, Iowa.

Second vice president, John Shepard III., WNAC, Boston.

Secretary, J. Elliott Jenkins, WDAP, Chicago.

Treasurer, Powel Crosley, Jr., WLW, Cincinnati.

The directors chosen were: Harold Power, WGI, Medford Hillside, Mass.; William S. Hedges, WMAQ, Chicago; Bowden Washington, WLAG, Minneapolis; Henry J. Rumsey, WDAP, Chicago; Leon Samuels, WJAR, Providence, R. I.; W. S. Harris, WLAG, Minneapolis; G. Brown Hill, KVQ, Pittsburgh, and Robert Shepard, WEAN, Providence, R. I.

562 Broadcasters

Sixteen broadcasters closed down their stations during September, while fifteen new ones opened. This shows a loss of one broadcaster for the month, leaving 562 stations on the air. These stood as follows on October 1: 260 Class A; forty-five Class B; 255 Class C and two Class D (development).

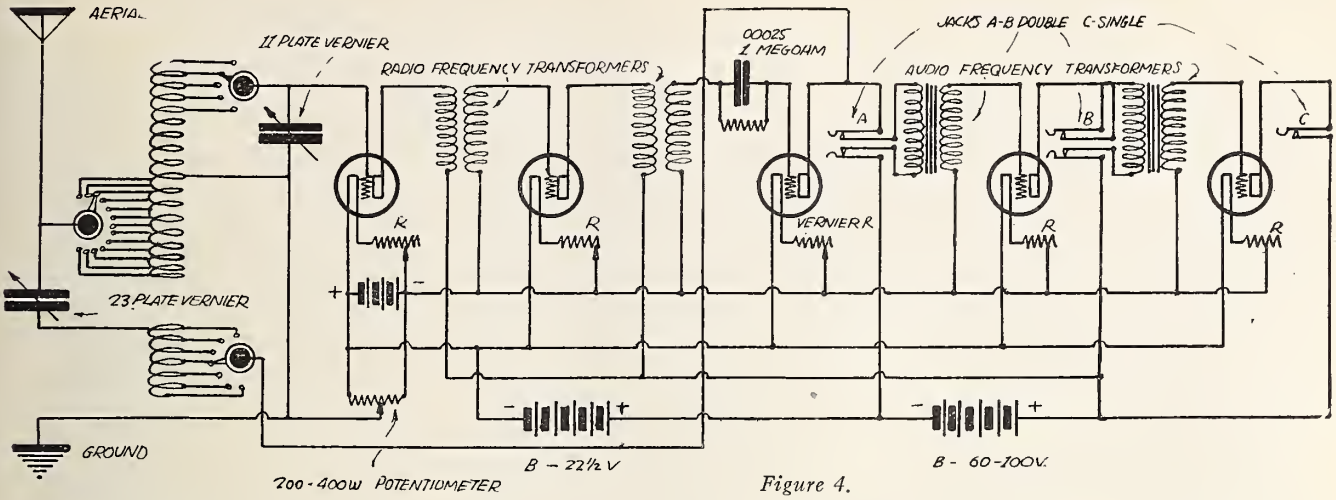


Figure 4.

the wave of KYW (536 meters) may be efficiently tuned in on an average antenna with the coils as described in the August issue.

L. W. O., Glenmora, La.

Question: As one of your subscribers, am coming to you for a little help on rewiring my set. It is a nonregenerative radio frequency receiver. I tore the blame thing down, and now can't get it back together again. I am sending a rough sketch the way the various parts are situated on panel and back, and would appreciate it greatly if you would draw in the proper way the wires should be attached. I left out the grid condenser or leak as I did not know where it went.

Answer: I am returning herewith your isometric sketch with the wires drawn in, and am printing in Figure 4, the correct electrical connections for the set you mention.

D. M. T., Boulder, Colo.

Question: In the August number of your magazine on page twenty-six, you have a diagram of a regenerative set, and I would like to have a diagram of the two stages of audio amplifications which can be used with this circuit.

Answer: The diagram you wish was printed in Figure 2 of the September Troubleshooter section.

J. S., Bronx, N. Y.

Question: I am a reader of RADIO AGE, and I notice that you print good diagrams. I wish you would print a diagram of a one tube set using spider web coils and condensers.

Answer: I am printing in Figure 1, a copy of the circuit you can use with the apparatus you mention. If operated intelligently it should give very good results.

J. B. S., Cicero, Ill.

Question: Am considering building a large set. Could you send me a circuit that would receive any station from coast to coast on loud speaker, that would tune out local stations and also that would eliminate static?

Answer: I am sorry to say that I cannot give you a copy of a circuit that I could guarantee would do all those things, but I am sure you will find that the super heterodyne described in this issue will interest you when I tell you that a set of this type was used in the amateur transatlantic tests, and got results, and the navy and other government stations use it with great success. I heard of an amateur experimenter having picked up 2LO in London, England, from a point somewhere around New York, and I think that it speaks pretty well for the circuit. As far as the static is concerned I cannot do much for you, nor can anybody else.

L. F. M., Kansas City, Mo.

Question: I have constructed a Kaufmann circuit which does not give satisfactory results. I have followed instructions with the exception of a switch of eight taps on the ground side of the variocoupler. Connections are well soldered and tested many times but the volume is no greater than I get on a crystal set. I have received long distance but once which was Omaha two hundred miles distant, and which came in very faintly. I have placed the active twenty coil directly beneath the condensers and the position of the switch of same seems to make very little difference. I wound my own coils which may be the source of the trouble. I filled the rotor with 24 wire which took 140 turns and I have 70 turns on the primary tapped every 8 turns, with 8 individual turns. Should I add another tube? If so, please send me a diagram for connecting it. I am a great believer in the Kaufmann circuit, and think the fault is with me and not with the set. I am using WD 12 tubes, and have tried new batteries with the same results. When first constructed the set gave good results with the tube burning very dimly, but now it will not work unless it is burning very brightly. I hope you can locate my trouble from the poor description I can give you. I follow RADIO AGE each month for improvements and have tried a condenser in the antenna which does not increase the volume at all.

Answer: Your variocoupler secondary is too big, and if you will decrease the number of turns on the secondary of the variocoupler to about 70 turns, you will find that your results will be much better. Inasmuch as you heard WOAW, which transmits on 527 meters, it leads us to believe that your set is tuning much too high. I also wish to suggest that the addition of another B battery so as to raise the plate voltage on the detector tube will probably make the set work better. You might make sure that you are using a condenser of .00005 mfds as designated, as this is a small but important feature in the set. The grid leak adjustment is also an important matter. I am sending you herewith a diagram showing how a stage of audio frequency amplification may be added.

S. S. Quincy, Ill.

Question: I would like to know if a plate variometer can be used in the Cockaday circuit as per the enclosed diagram with any additional increase in efficiency? Is it possible to make a variometer from a variocoupler by connecting the secondary and primary of the variocoupler in series?

Answer: The variometer stunt you suggest will not work very well, inasmuch as the set is already a tuned plate affair with the coil B. This makes the variometer unnecessary. The use of an audio transformer will require another tube, connected in the manner shown in the August issue. The variometer made out of a variocoupler as you suggest will not give results anywhere equal to those of a regular variometer, and I feel that you would profit in buying a regular variometer should you decide to make a circuit using one.

If your newsdealer has sold out his supply of Radio Age you are likely to miss just the hook-up that you have been looking for. To avoid any such chance fill out the coupon in this issue and send in your subscription. Then you will be safe. And don't forget that with each subscription at the special price of $2.00 a year, or $1.00 for six months, we send you free the popular Reinartz Radio booklet FREE. Address Radio Age, 500 N. Dearborn Street, Chicago, Ill.

Pick-Up Records by Our Readers

LAST summer we heard several pessimists make the remark that radio was dead—that it would not come back in the same manner as it did last year, and that its period of usefulness as an entertainment was past. They contended emphatically that the novelty of listening had worn off and that the general radio public was no longer interested.

We wish that we could have taken some of those doubting Thomases and shown them the mass of inquiries asking for information on how a set could best be improved, and put into shape for winter months, and want to call the attention of those pessimists to the fact that the broadcasting stations are increasing their programs, and various other developments in radio responding to the demand caused by the overwhelming increase in public interest.

If you'll take a tip from us, we predict the greatest radio season ever staged, and we base our decision on letters similar to the ones we are printing herewith. Day by day, in every way, the conditions necessary for satisfactory radio reception are becoming more ideal, and if you haven't already put your set into the good receiving condition, by all means do so—you're missing out on something great.

THE EDITOR.

RADIO AGE,
Gentlemen:

I built a Cockaday receiver according to your article and diagrams in RADIO AGE of August.

With a U V 200 detector unit, I get Fort Worth, Atlanta, St. Louis, Kansas City, Schenectady, Troy, Buffalo, Detroit, and many others; even while local stations are broadcasting, I bring in WLW, Cincinnati.

Not alone is the Four-Circuit Tuner a super-selective receiver, bringing in loud and clear the weak long distance station over the strong local stations; it reaches out to infinite distance, bringing in clearly and perfectly audible that heretofore evasive and much desired long distance station, and without the mushy groans and body capacity accompanying distance tuning with other sets.

I find that the 17-plate condensers are absolutely necessary in the set, and are unquestionably more preferable than the 23-plate type, the latter being too critical. I would recommend that every fellow using this circuit install condensers of the vernier type, as closer tuning can much more easily be effected.

The Four-Circuit Tuner is a *joy*, and I hereby propose a vote of thanks to Lawrence Cockaday, and to those who have helped develop this superlative receiver. Sincerely,

WARREN C. WOOTTEN.
4648 North Winchester Avenue, Chicago, Ill.

The above letter goes to show that even admitting that public interest in radio decreases during the summer months, RADIO AGE does not slow up on printing the best stuff. It also demonstrates the necessity of your reading RADIO AGE regularly if you "want to keep up with the crowd." Thank you, Mr. Wootten, for the kind interest shown in the matter. When we find that our articles and information can make a fellow react sufficiently to take the time to write us a letter we know it must have hit the right spot.

RADIO AGE,
Gentlemen:

On Labor Day I constructed a Cockaday four-circuit tuner as shown in your August number and up to last night have caught the following stations: KSD—St. Louis, PWX—Havana, WDAF—Kansas City, WDAP—Chicago, WFAA—Dallas, WGM—Atlanta, WGR—Buffalo, WHAS—Louisville, WHB—Kansas City, WJAZ—Chicago, WLAG—Minneapolis, WLW—Cincinnati, WMC—Memphis, WOAW—Omaha, WOC—Davenport, WOS—Jefferson City, WSAI—Cincinnati, WSB—Atlanta, WSY—Birmingham, WNAV—Knoxville, WCBD—Zion, and WTAS of Elgin, Ill.

From the above list you will note that I have caught stations whose wave length range from 309 meters (Cincinnati) to 547 meters (St. Louis). All the above were caught with one stage of audio amplification, using WD 11 tube and only 22½ volts on the plate of the amplifier.

Last winter I built several Reinartz sets and have had very good success with them all but I believe that the four-circuit tuner is superior to any. WMC (Memphis) is a very strong station, located not over two miles from my home, but I can tune them out and when I say tune them out, I mean that I don't get even a slight whisper from them. Am going to add another stage of audio frequency to my set and expect to get some real pleasure out of it this winter.

The Cockaday circuit is extremely simple to make, and not very expensive, and it has a Reinartz circuit beat a hundred ways for simplicity of operation.

Yours very truly,
FRANK A. FLECKENSTEIN.
Memphis, Tenn.

What do you say to that, you fellows with Reinartz sets? We know that the Reinartz is a mighty good circuit, and is hard to beat, but Mr. Fleckenstein backs up his contention with a pretty good list of stations heard. What about the Kopprasch, fellows? Can you beat this Cockaday record of hearing as many stations in the period of time Mr. Fleckenstein heard (from the third to the twelfth of September)? Let's have your lists.

By golly—here's a letter from George W. Jeffers, of Pennsgrove, New Jersey. He's the fellow who wrote us all about his experiences with the Kaufmann circuit. Wonder what he's got to say. We printed his letter in RADIO AGE, and he probably didn't like it.

RADIO AGE.
Dear Sirs:

I see by the last issue of the RADIO AGE that you did everything but print my picture in the Kaufmann matter. I don't remember, but I think I stated in my last bunch of chatter that you could certainly pick the good things. I have built to date according to your specifications and illustrations, the following sets for my own personal use, and think that you will probably be interested in knowing what I think of them.

The Reinartz is a world beater; the Cockaday four-circuit very good; the Kopprasch was playing with this outfit about thirty minutes the other night and it brought stations in so fast that I could not log them. I told you all about the Kaufmann some time ago. It surely is a fine circuit, and then the little Erla reflex. I had the night off last night and went "fishing" around with the set, and caught the following:

WJAR, WMAF, WBZ, WGY, WEAF,

(*Continued on page 38.*)

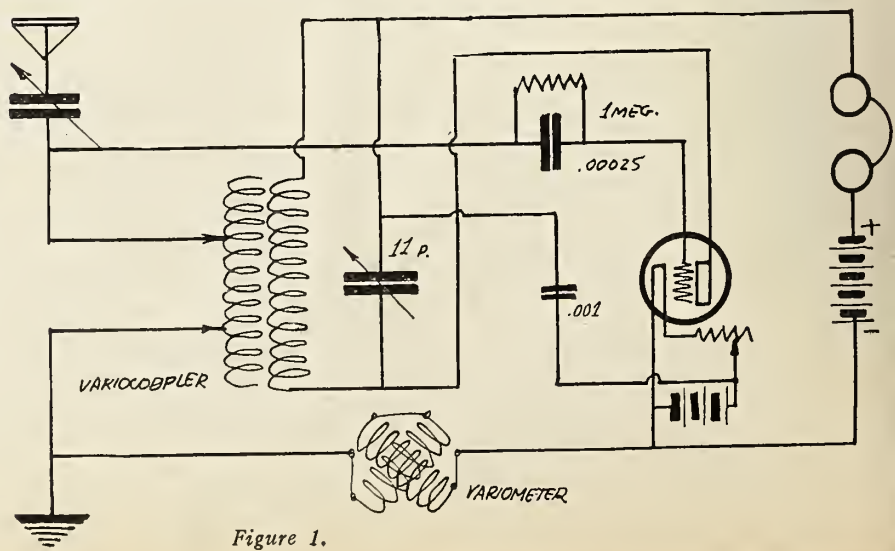


Figure 1.

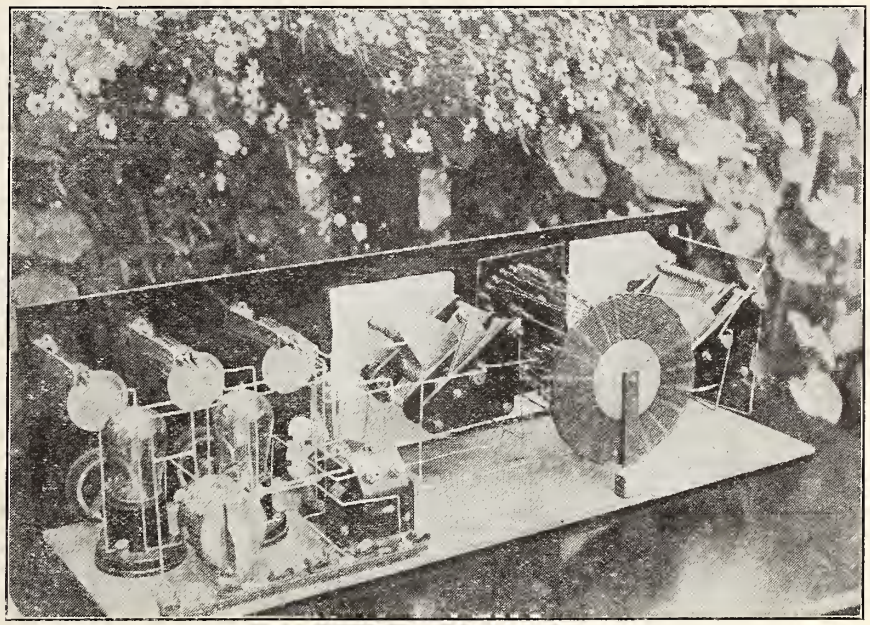
Little Things That Help

Plate Battery Adjustment

THERE are times when tubes operate more efficiently on higher or lower plate voltages than specified, and often the matter of the addition of one or two volts is hard to accomplish when block B batteries are used.

A set may bring in the carrier wave of some long-distance station, but difficulty may be experienced in bringing the set up to the oscillating point without the tube "spilling" over, and starting to oscillate, distorting the signal, and often requiring tedious and painstaking tuning. The filament voltage may be decreased to a point where the set stops oscillating, and signal disappears with the click, and if the amount of resistance in the filament circuit is decreased the click is again heard, and the set begins to oscillate again without bringing in the voice or music.

If this is experienced usually a decrease in plate battery will compensate for the difficulty, and the signal will usually come in strong and clear with a decrease of two to four volts in the plate circuit of the detector. However, it is sometimes the opposite, and the tube will not function efficiently with only 22½ volts, and requires an additional amount of plate voltage. If your tube is a hard one, and fails to oscillate, the best way to make it do so, is to procure another 22½ volt battery or about five flashlight cells, and add them in the manner shown in Figure 1. In this manner close adjustment of the plate voltage is effected, with the gain of proper efficiency from the tube.



How to Lay Out That Reinartz Panel

THE accompanying photograph is an ideal arrangement of apparatus for the Reinartz set, and we are printing the layout because it shows clearly the mounting, shielding and arrangement of parts used in the Reinartz. The set is the property of Fred C. Meynert, of 4914 Waveland Avenue, Chicago, Ill., who hears many long-distance stations.

All of the tuning controls are placed at the left-hand side of the panel, and are shielded carefully with tin foil, fastened to the panel with shellac. Note especially how the transformers are placed at right angles to reduce inductive effects.

A Bradleystat is used in the first stage to facilitate close filament control on the detector. One of the novel features of the set is the placing of the binding posts on the back of the mounting board as shown.

Flewelling

Radio Age:

What has become of all the Flewelling enthusiasts? From local observation it seems that most of the fans are disgusted with the set. Until a few days ago I was among this class, but since I had the coils and a WD 11 tube and a 23-plate condenser lying around the house I made up my mind that I would give it another chance, so I went to a regular radio store and got three of the .006 condensers such as are mounted on the CRL grid leak and condenser and a ½ meg. grid leak, one of those capsular looking ones and a CRL condenser with the grid leak attached, and a new dry cell. Went home and hooked the set up in about two hours and was listening to Chicago stations at 9:30 p. m. and the following evening I heard the same Chicago stations, the Drake and the Edgewater as well as WOAW at Omaha.

The hook-up that I used may be the same as any other hook-up in circulation for this set, but it was one of the number of hook-ups given out by the Charles Freshman Company, and is just a circular, advertising the parts that they manufacture for the particular set.

I have my set on the second floor and the lead-in wire is about fifty feet long and the ground wire is about the same length; my aerial is a four-wire flat top, fifty feet long. I have but one binding post on the set and that is where one would ordinarily connect the aerial, I have no binding post for a ground connection, and find that on local stations the tube is taxed to its fullest capacity by connecting both the aerial and ground to this one binding post, though excellent results are obtained with either aerial or ground singly or with a piece of wire, thrown on the floor about six or eight feet long. On long distance stations I find that the best results are obtained by using only the ground wire. I am using the WD 11 tube with a single dry cell and use only 16½ to 18½ volts of B battery on the distant stations, but the B battery voltage can be increased on the local stations.

I thought, perhaps, some of the fans would be interested to know that this circuit will really give wonderful results if high-class equipment is used and care is taken in wiring.

Yours very truly,
G. F. McCULLOUGH,
451 Fillmore Street, N. E.. Minneapolis, Minn.

Primary Condensers on AF Transformers

IN AN oscillating detector circuit the capacity of the telephone cords (which is of the order of 75 MMF.) is often sufficient to by-pass the radio frequency current around the high inductance of the phones, but when the primary of an amplifying transformer is substituted for the phones, it should be shunted with a condenser of a few hundred micromicrofarads or more.

Ultra Audion Coil

Further tests with the Ultra Audion circuit, described and illustrated in the October number of RADIO AGE, indicate that a spider web coil, with 75 turns, will produce better results than can be obtained from the honeycomb coil, as shown in the illustration last month.

Ratification has been made of the contract between the French Compagnie General de Telegraphie Sans Fil and the Russian Radio Electric Trust, according to cable advices from Trade Commissioner Butler, at Paris. The Agreement provides for the installation of wireless stations and manufacture of apparatus in Russia.

The Auditory Method of Learning the Radio Code

By FELIX ANDERSON

Technical Assistant, Radio Age and Kendall North, Radio 9BDL.

WE PRESENT herewith the means of getting the very most out of that receiver of yours. The authors explain in a series of two articles the fundamental steps in learning the radio code, how to avoid doing the wrong things, and outline a series of steps for the novice to follow in the process of learning to copy. The system described utilizes a procedure widely different from the customary memory or visual systems, inasmuch as it appeals to the faculties of hearing and the ability to write instead of seeing and saying it. You can acquire this fascinating branch of radio in a remarkably short time and considering the pleasure and benefits it affords, it is certainly worth while to know it.

Before we go any further let's get on a sound basis. Those who are interested exclusively in programs and entertainment over the radio, raise their hands. . . . Now those who raised their hands pass on to the next article, as these lessons will not interest them.

We assume that the fellows who didn't pass on to the next article are interested in experimenting and improving themselves and their sets to the *n*th degree, and are interested in getting as much as possible out of their efforts applied to radio. We don't want to waste your time so before we go any deeper into this matter we want to assume the correct attitude toward this new attempt, and we will tell you quite frankly that you won't realize much out of code and copying unless you apply some real honest-to-goodness interest at the start. After you have mastered the first obstacles you will find that it is only a matter of your spending the time to reap the benefits. You will find new phases of the game open to you, that you never dreamed you could command.

You'll have to admit that you are one of those fellows who listens to about one-half of a number of a program from some DX broadcast station, and after getting the call and putting it down with all the accompanying thrills, you start all over again and "fish" around for more distant stations, more calls, and look for greater and more thrills. The better the receiver works, the more programs you hear, and the shorter the program, the more stations you put down. Isn't that so? We've heard some fellows cuss and fume at some announcer and performer for not announcing oftener, and for not making their renditions shorter. Probably you are the very fellow we mean.

Summing it all up, your entire interest seems to be centered upon the call of the station, and not upon what the station is broadcasting.

You are just the fellow who ought to learn the code.

Sound Chart of Radio Code

SOUND	LETTER
dit	E
di dit	I
di di dit	S
di di di dit	H
di di di di dit	5
DAH	T
DAH DAH	M
DAH DAH DAH	O
DAAAAAAAAAH	O (Zero*)
di DAH	A
di DAH DAH	W
di DAH DAH DAH	J
di DAH DAH DAH DAH	1
DAH dit	N
DAH DAH dit	G
DAH DAH DAH DAH dit	9
di DAH DAH dit	P
di DAH di dit	L
DAH di dit	D
DAH di di dit	B
di di DAH	U
di di DAH DAH DAH	2
di di DAH dit	F
DAH di DAH	K
DAH di DAH dit	C
DAH di DAH DAH	Y
DAH DAH di DAH	Q
di DAH dit	R
di di di DAH	V
DAH di di DAH	X
DAH DAH di dit	Z
di di di DAH DAH	3
di di di di DAH	4
DAH di di di dit	6
DAH DAH di di dit	7
DAH DAH DAH di dit	8
DAH di di di DAH	BK
di di DAH DAH di dit	? mark
DAH DAH di dit DAH DAH	! point**
di dit di dit di dit	Period
DAH di DAH di DAH	Attention

*Zero is sometimes sent as 5 DAHS.
**Also used as method of expressing laughter.

You probably don't think that listening to code signals can afford much pleasure and entertainment, but just for an experiment, let's sit down in front of that receiving set of yours, and tune it down to about 185 meters. You say surely—that's where you hear the code; it's about the most meaningless bedlam of dots and dashes you ever heard, and means about as much to you as a wooden leg to a marathon dancer. You never give the matter thought except when the code-senders interfere with your reception of BC signals. Single one of those fellows out, and let's copy him. You'll probably hear something like this:

2BGF 2BGF 2BGF de 7ZV 7ZV 7ZV GE MSGS ER QSR? 2BGF de 7ZV k.

What does all this mean? Let's decode it into plain American language. That's station 7ZV, somewhere up in the western part of the state, talking to another amateur on the Atlantic seaboard. 7ZV is calling 2BGF, greeting him good evening, telling him that he has messages and wants to know if 2BGF won't relay them for him. The k on the end of the transmission is the invitation to send. In all probability you didn't think that you could hear so far with your receiver, and are astonished at hearing this distance, but when one considers that to a little over seven hundred broadcast stations transmitting over a wide range of waves, there are more than ten thousand active amateur stations being operated over a wave band of from 150 to 200 meters, the matter begins to seem plausible. Your chances for distance on code signals versus broadcast signals are about three times as great.

It is not necessary to restrict oneself to amateur code signals. The reader can load his set up to 600 meters or higher and receive ships, naval stations, foreign and domestic commercial stations as well as the high-powered long-wave government stations maintained all over the world. You can copy press and news dispatches France, South America and if your set is working well, even Dutch Java is possible. And there is also the much sought thrill of hearing the world-silencing cry, S O S, from some unfortunate ship.

After you have learned the code sufficiently well, you can apply for a license, and enter the transmitting game, with its manifold pleasures and its unlimited entertainment.

What we started out to tell you about was how to learn the code, and we regret to say that space does not allow us to tell you about the thrills and entertainment furnished by reception of code signals from ships, Polar expeditions, naval stations all over the world, hearing press reports, distress signals and amateur traffic and we feel sure that learning the code will hold as much for you as it did for us.

Getting back to the original theme, we want to tell you of the methods *not* to use in learning the code.

About the worst thing you can do is to take a code chart and sit down and tediously memorize it visually. The point is this. You don't sit down in front of a receiver with the head set on and see the signals—you hear them. When you hear them you don't say dot, dash, or equivalent—you write them down. If

(*Continued on page 32.*)

Schenectady Gives the English a "Kick"

TWENTY-ONE English radio fans have written WGY, the General Electric Company broadcasting station, announcing successful reception of the Schenectady station's program during the first week in September. WGY and other American stations have been heard frequently by the English fans but trans-Atlantic transmission is rather unusual at this period of the year.

Many of the writers compare WGY with the transmitting stations in England and on the continent and a majority of them refer to programs broadcast September 6 and 8. W. E. Philpott of Rye, Sussex, England, picked up WGY in the early morning of September 1. He writes: "I was rather 'bucked' up with the results. Congratulations on the fine modulation. You were quite equal to Birmingham and Manchester."

Henry Meyers, of Low Fell, Durham, England, heard WGY and writes: "For consistent strength and clarity the concert came through much better than I get the London transmission."

J. Rhodes writing from Leeds, Yorkshore, England, said WGY was as "clear as Manchester, forty miles away."

The report of H. L. Holt, of Manchester, England, is especially interesting inasmuch as he received WGY on an indoor aerial. He writes:

"The apparatus I was using consists of an indoor aerial across the kiddies' bedroom and the ordinary detector and one stage of low frequency. The aerial is just a length of bell wire stretched backwards and forwards across the room in the form of a W and a V and then through the floor to the living room below the set. The tuner is just an ordinary single circuit regenerative one."

Reception on a loud speaker strong enough to wake a person sleeping upstairs with bedroom door shut, is reported by T. Hall Felton of Grimsby, England. Mr. Felton was listening in with his father, Dr. E. H. Felton, who is vice-president of the Grimsby District Radio Society. He has a five valve (tube) experimental set. "On two high frequency valves," he writes, "you are as loud as the English stations on three valves. In operating the loud speaker five valves were used." Mr. Felton picked up WGY on September 4, 6 and 8.

H. Constable, of London, heard speech and music on September 1. "At 5:23 a. m. I heard your station working and easily got your speech and music on a small loud speaker. I got you comfortably on one high frequency and one detector valve and with two note magnifiers worked the loud speaker." Mr. Constable sent in a log but failed to get the name of a hymn. In place of the name he wrote a portion of the melody in musical notation. This was recognized and it checked perfectly with the WGY station log.

It would appear from the letter of Gilbert Davis, of Magheramorne, via Belfast, Ireland, that American broadcasting stations threaten to cause violation of law in Ireland. Mr. Davis writes: "I can get your music any evening but your speech only when X's are fairly quiet. Your transmission is far better than any in Paris or The Hague. Owing to my set having only three valves (one detector, one high frequency and one amplifier) most of my friends are very doubtful as to my getting you, and as 'curfew at 12' exists still over here and I cannot let my friends listen in for themselves."

In addition to the letters received from Great Britain, WGY received letters from E. M. Bacigalupi, of Hillyard, Washington, Chris Maginn, Jr., of Aberdeen, Wash., and Paul Bernier, of Shaunavon, Saskatchewan, mentioning reception of the program of Sept. 8.

Dr. Charles P. Steinmetz, peer of electrical wizards, photographed for RADIO AGE at the LaSalle Street railroad station, Chicago, on October 11. The great engineer was on his way to Schenectady from the West, where he had been enjoying a rare vacation trip. He is chief engineer of the General Electric Company. Radio fans hold the little gentleman almost in reverence because of his vast knowledge of the mysteries of wireless.

Drama at WGY

The WGY Players opened their second season (1923-1924) at the General Electric Company broadcasting studio, Schenectady, Thursday night, October 4. The play was "Three Live Ghosts." During the previous season, forty-three plays were presented. Plans for the new season include the acting of one play weekly. As a result of the receipt of over 6,000 letters, over a four-day period, "The Sign of the Cross" will be repeated. Among the other productions planned will be a special adaptation of "County Fair," by Neill Burgess.

Several new features will figure in the 1923-1924 season. Plays selected from those written especially for radio as a

(Continued on page 38)

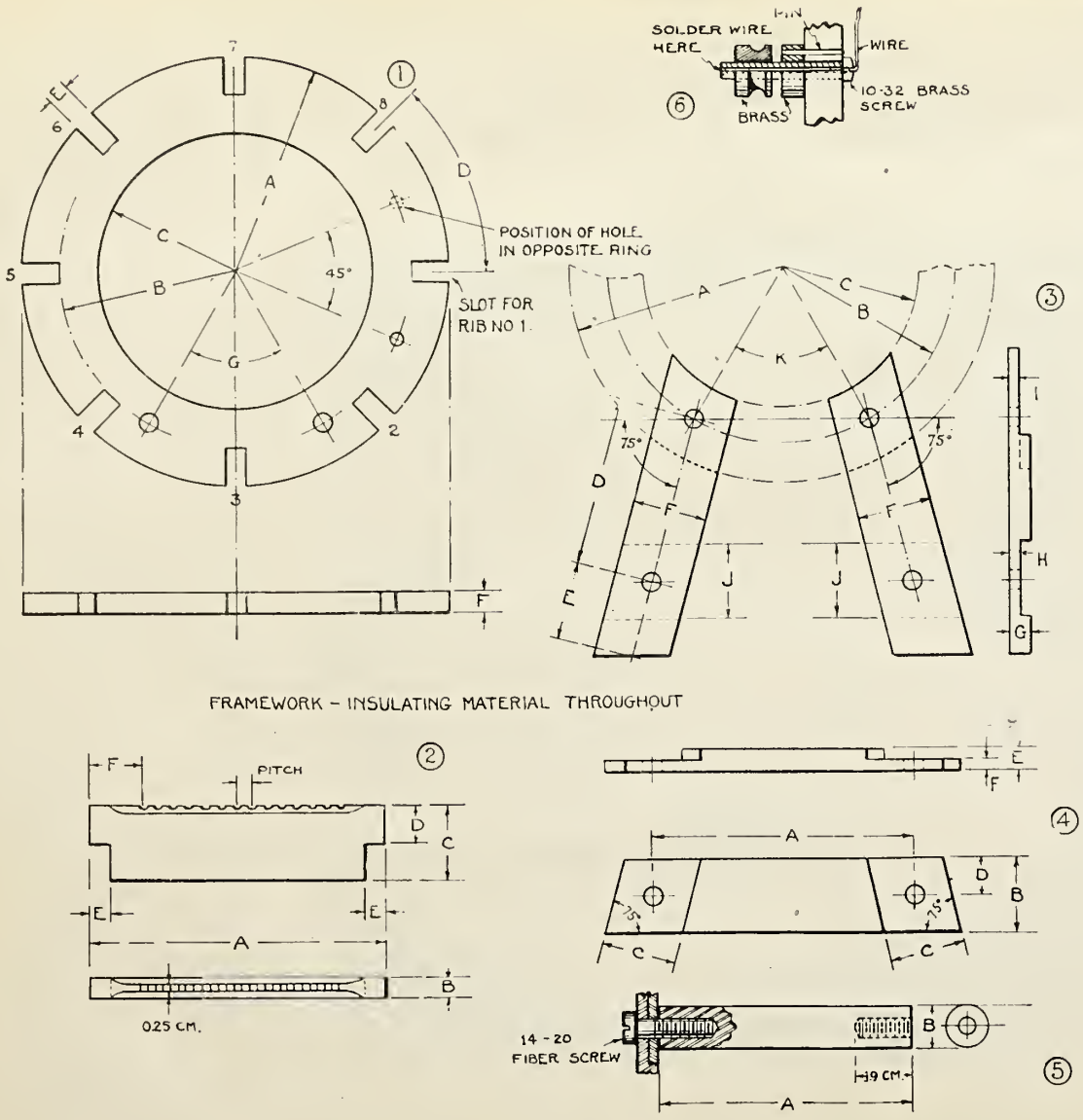


FIG. 2.- WORKING DIMENSIONS FOR PARTS OF INDUCTANCE COIL FRAMEWORKS.

FRAMEWORK FOR GROUP I. DIMENSIONS IN CENTIMETERS.
COIL NO. 1, PITCH 0.6 cm; NUMBER OF TURNS 8

SYM.	REQ.	DESCRIPTION	A	B	C	D	E	F	G	H	I	J	K
1	2	RING	6.24	5.12	4.01	45°	0.64	0.95	58.5°				
2	8	RIB	8.71	0.64	2.22	1.11	0.95	1.95					
3	2	LEG-RIGHT	6.24	5.12	4.01	4.92	2.05	2.22	0.95	0.48	0.48	2.23	58.5°
3	2	LEG-LEFT	6.24	5.12	4.01	4.92	2.05	2.22	0.95	0.48	0.48	2.23	58.5°
4	2	END BRACE	7.56	2.22	2.22	1.11	0.95	0.48					
5	2	BRACE ROD	7.75	1.27									

FRAMEWORK FOR GROUP II. DIMENSIONS IN CENTIMETERS

COIL NO. 2, PITCH 0.6, TURNS 8									A-SYM. 2, 8.71			A-SYM. 5, 7.75	
" 3 " 0.6 " 10									" " 2, 9.91			" " 5, 8.95	
" 4 " 0.6 " 13									" " 2, 11.71			" " 5, 10.75	
" 5 " 0.4 " 14									" " 2, 9.51			" " 5, 8.55	

SYM.	REQ.	DESCRIPTION	A	B	C	D	E	F	G	H	I	J	K
1	2	RING	8.32	7.05	5.78	45°	0.64	0.95	61.5°				
2	8	RIB	*	0.64	2.54	1.27	0.95	1.95					
3	2	LEG-RIGHT	8.32	7.05	5.78	5.72	2.29	2.54	0.95	0.48	0.48	2.55	61.5°
3	2	LEG-LEFT	8.32	7.05	5.78	5.72	2.29	2.54	0.95	0.48	0.48	2.55	61.5°
4	2	END BRACE	10.19	2.54	2.54	1.27	0.95	0.48					
5	2	BRACE ROD	*	1.27									

*GIVEN ABOVE

FRAMEWORK FOR GROUP III. DIMENSIONS IN CENTIMETERS

COIL NO. 6, PITCH 0.6, TURNS 15									A-SYM. 2, 12.91			A-SYM. 5, 11.95	
" 7 " 0.6 " 19									" " 2, 15.31			" " 5, 14.35	
" 8 " 0.4 " 22									" " 2, 12.71			" " 5, 11.75	
" 9 " 0.4 " 28									" " 2, 15.11			" " 5, 14.15	

SYM.	REQ.	DESCRIPTION	A	B	C	D	E	F	G	H	I	J	K
1	2	RING	12.0	10.41	8.83	30°	0.64	0.95	80.5°				
2	12	RIB	*	0.64	3.18	1.59	0.95	1.95					
3	2	LEG-RIGHT	12.0	10.41	8.83	8.38	2.77	3.18	0.95	0.48	0.48	3.18	80.5°
3	2	LEG-LEFT	12.0	10.41	8.83	8.38	2.77	3.18	0.95	0.48	0.48	3.18	80.5°
4	2	END BRACE	17.83	3.18	3.18	1.59	0.95	0.48					
5	2	BRACE ROD	*	1.27									

*GIVEN ABOVE

FRAMEWORK FOR GROUP IV. DIMENSIONS IN CENTIMETERS

COIL NO. 10, PITCH 0.4, TURNS 28									A-SYM. 2, 15.11			A-SYM. 5, 14.15	
" 11 " 0.4 " 37									" " 2, 18.71			" " 5, 17.75	
" 12 " 0.4 " 48									" " 2, 23.11			" " 5, 22.15	
" 13 " 0.2 " 50									" " 2, 12.91			" " 5, 11.95	

SYM.	REQ.	DESCRIPTION	A	B	C	D	E	F	G	H	I	J	K
1	2	RING	15.86	14.27	12.68	30°	0.64	0.95	76°				
2	12	RIB	*	0.64	3.18	1.59	0.95	1.95	= COIL 13				
3	2	LEG-RIGHT	15.86	14.27	12.68	9.53	3.28	3.18	0.95	0.48	0.48	3.18	76°
3	2	LEG-LEFT	15.86	14.27	12.68	9.53	3.28	3.18	0.95	0.48	0.48	3.18	76°
4	2	END BRACE	22.43	3.18	3.18	1.59	0.95	0.48					
5	2	BRACE ROD	*	1.59 1.27 = COIL 10 & 13									

*GIVEN ABOVE

FRAMEWORK FOR GROUP V. DIMENSIONS IN CENTIMETERS

COIL NO. 14, PITCH 0.4, TURNS 65									A SYM. 2, 28.91			A-SYM. 5, 27.95	
" 15 " 0.2 " 66									" " 2, 16.11			" " 5, 15.15	
" 16 " 0.2 " 86									" " 2, 20.11			" " 5, 19.15	
" 17 " 0.2 " 114									" " 2, 25.71			" " 5, 24.75	

SYM.	REQ.	DESCRIPTION	A	B	C	D	E	F	G	H	I	J	K
1	2	RING	20.24	18.33	16.43	22.5°	0.64	0.95	76.5°				
2	16	RIB	*	0.64	3.81	1.91	0.95	1.45					
3	2	LEG-RIGHT	20.24	18.33	16.43	11.94	3.96	3.81	0.95	0.48	0.48	3.82	76.5°
3	2	LEG-LEFT	20.24	18.33	16.43	11.94	3.96	3.81	0.95	0.48	0.48	3.82	76.5°
4	2	END BRACE	28.8	3.81	3.81	1.91	0.95	0.48					
5	2	BRACE ROD	*	1.59 1.27 = COIL 15									

*GIVEN ABOVE

$4,000,000 for Radio

Schenectady, N. Y.—Six radio transmitters, to be the most powerful on the American continent, operating from vacuum tubes and first to make use of the General Electric twenty-kilowatt radiotron, are being installed by the United Fruit company and the Tropical Radio Telegraph company at points in Central America and the United States for the purpose of completing the links of an adequate communication system between the Americas.

These transmitters will be located at: New Orleans, Miami, Puerto, Barrios, Guatemala, Tegusigalpa, Honduras, Managua, Nicaragua and Almirante, Panama.

The Tropical Radio company operates the stations at New Orleans, Miami, Tegucigalpa and Managua, while the stations at Puerto Barrios and Almirante are operated by the United Fruit company.

The first of these six sets ordered by the Radio corporation for the United Fruit company has just been completed at the Schenectady works of the General Electric company, and will be shipped within a few days to the Tegucigalpa station. The other five are scheduled to be completed and shipped at the rate of one a month, and, as about two months will be required to install each set, it is expected all six will be in operation by the middle of next year.

The United Fruit company established the first radio stations in Central America and was the first to establish commercial radio communication between Central America and the United States. It was shortly after the international yacht races off Sandy Hook had been reported by radio that the first sending and receiving sets were purchased and installed at Port Limon, Costa Rica, and Bocas del Toro, Panama. This was in 1904 and service was inaugurated the following year.

The operation of these two stations convinced the directors of the United Fruit company that radio was practical and valuable in a business which handled such a highly perishable product as the banana. So the year following, or 1906, stations were opened at Bluefields and Rama, Nicaragua.

All these stations, because of the lack of land communications, handled in addition to the company's business a large share of the telegraph business of the general public between these places and the United States and Europe. Other stations have followed since then until now, with the six new tube transmitter stations, there will be a total of nineteen, comprising what is known as the United Fruit company's radio system.

The United Fruit company has spent more than $3,000,000 in the development of its radio system and upon the completion of new stations under construction its investment in radio probably will exceed $4,000,000.

No wonder General James G. Harbord was interested when he found a radio set at the New York show, which had been captured from the Germans at Chateau Thierry. The General was there in 1918 and it was the American outfit, part of which was under his command, that finally gained a victory over the Kaiser's picked forces. General Harbord is now president of the Radio Corporation of America.
(Kadel & Herbert, Foto)

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If you have not bought your Reinartz Book, fully illustrated with hook-ups and clear description of how to make this popular circuit, send $2.00 in money order or currency and we will send you the booklet "Reinartz Radio" and place you on the subscription list of Radio Age for one year. Address Radio Age, 500 N Dearborn Street, Chicago, Ill.

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Don't let Body Capacity interfere. Use our pane shielding which is applied to any set in five minutes without removing instruments. Price 35c. H. & M. Specialty Co., Box 66, Brighton, Mass.

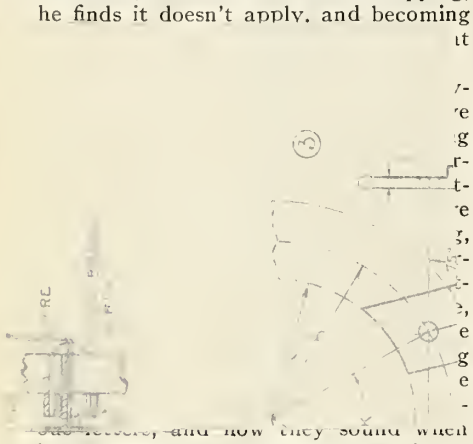
If your newsdealer has sold out his supply of Radio Age you are likely to miss just the hook-up that you have been looking for. To avoid any such chance fill out the coupon in this issue and send in your subscription. Then you will be safe. And don't forget that with each subscription at the special price of $2.00 a year, or $1.00 for six months, we send you free the popular Reinartz Radio booklet FREE. Address Radio Age, 500 N. Dearborn Street, Chicago, Ill.

Learning the Radio Code

(Continued from page 22.)

you visualize the code, it will only mean that you have wasted your time, and that you will have to start all over again. Don't do it! That's just about the way the average beginner gets started on code copying, and that probably accounts for some of the rotten copying (called "hogwash" by real amateurs) and it also will testify to some of the terrible sending and spacing (called "fist" and QSC by amateurs) one hears on the air sometimes.

We've seen several code system teaching charts ranging, some pretty high, some fair, and others absolutely worthless. Most of them appeal to the beginner's ability to remember a jumble of words, and as a rule with few exceptions end up in a jumble. The beginner tries to remember a whole lot of word combinations, and when it comes to copying, he finds it doesn't apply, and becoming



heard over the air through the receivers.

About the easiest way to imitate a code letter is to resort to the old, baby saying of DAH. This sound will just about imitate the letter T in code as it is transmitted from a high power spark set, and represents the dash element in code letters. The only other and important sound heard over the air in code is the dot which can be very well represented by the sound DI, sounding the I short, as in "it." By sounding DI you have the equivalent sound transmitted for the letter E. This sound when combined with the sound DI thusly: DAH dit (the t is added for easier enunciation) gives the letter N in radio code. Reversed thusly: di DAH (accenting in both cases the DAH) will give the sound one hears when the letter A is transmitted.

The dashes being three times as long as the dots (the DAH sound representing the dashes) must necessarily be accented, and the di sound should be made as short as possible to preserve the correct accent of the code character, in order that it may be easily recognized. The necessity of getting the DAH sound accented is demonstrated in the case of the letters C and N. If the dashes (DAHS) are not accented properly when the letter C is transmitted, the combination N N will result, whereas if the dashes are given the proper time duration and accent, the letter C will be sent properly. This applies to both receiving and transmitting, for if the letter C is sent poorly with improper accent, the receiver will hear n n, and if the sense of the copy he is making will not prompt him to change it, an error will result. The code is just full of these little possibilities for error, and it will be a wise move to get the accent of the individual dashes and dots fixed in mind so that trouble may be avoided later in copying.

The next step will be for you to get down to the actual business of training yourself to recognize these combinations of accented DAHS and less accented Dits as letters, and to train yourself to write the correct letter or number down when a certain sound or combination of sounds is heard.

Get a piece of paper and a pencil, sit down with the idea firmly set in mind that you are going to learn something if you never did before and with this chart do the following:

1. Run through the list of code sounds, paying no attention to what letters they are, at a moderate speed, to famaliarize yourself at saying the sounds and the various combinations of sounds as they appear. Don't pay any attention to the letters—that will come later. Remember—ACCENT THE DAHS!

2. After you have satisfied yourself that you have the sounds and accents correct, take your pencil and say "dit," writing down the letter E on the paper, next di dit, writing I, di di dit, writing S and so on down the list. Don't say the letters corresponding to the sounds out loud—write them down, because that's what you are going to do when you hear them later. When you hear di di dit, you won't say S out loud—you'll write it down on a piece of paper.

3. Do the same way with the DAH, DAH DAH, DAH DAH DAH (TMO) group and right on down the chart until you have the combinations of sounds firmly fixed in mind. The chart is arranged in the grouping according to the similar sounds to facilitate the learning of the respective letters, and also to avoid the customary fault of learning the ABCDE end of the code very well and neglecting the XYZ and number end of the alphabet.

After you have made sure that you are familiar with each letter and number of the code alphabet as shown on the chart, spell out simple words such as radio, message, received, etc., in code form using the dah dit sounds. If you are at home or in private, you can spell them out softly to yourself, if not, you can spell it out mentally. You can think out the words in code any place, no matter where you are, but bear in mind that you must concentrate on what word you are sending to yourself, so that when the mind received a certain accent or sound it will automatically substitute (or rather register) the corresponding letter of the alphabet.

After you have become more familiar with the code you will find that this comes without thinking—it becomes almost another sense, and you find you will find yourself associating different sounds you come in hearing range of, with code letters. It will probably arouse the humor of our readers when we say that the code has gotten so thoroughly into our systems that when walking along the street, we quite frequently find ourselves decoding mentally the various sounds as they issue from nearby automobile horns, inasmuch as they sound so much like code signals. But this is only an illustration to show how the reading and decoding of sounds becomes a part of your subconscious self, and the only way you can make it come to you without thinking, is to literally form a habit of thinking of the letters of the alphabet in the sense of sounds instead of a sort of mental vision of the letter when it is issued. You will be able to see this point more clearly as you proceed with the business of learning; as you keep on practicing, you will find that this understanding the code and recognizing the various letters state is creeping back into your head, and you begin to feel that they become part of you.

We might suggest that a good cure for insomnia is this business of learning the code. Try it some night when you can't go to sleep. Say different code letters, and different words in code, and see how quickly it takes your mind off worldly affairs, and makes a veritable machine out of you, busy at mentally registering and reflexing impulses of thought. Eventually, code will get you just as one of those songs you can't erase from your mind. The reader will probably recall that at some time there was some little ditty or tune that he couldn't get out of his head. The reason for it can be explained by the fact that it was sung mentally and out loud so often that before really realizing it, it is sung without any thought on the part of the singer. That's just about the way the code should affect you. You practice it until it comes without thinking. It becomes a part of your subconscious mind.

In concluding this installment, we want to impress upon our readers the necessity of learning every character shown on the chart—we have compiled it from actual experience in the code game, and know what you are expected to copy, and have not put any unnecessary letters or numbers or abbreviations on the chart, and we also wish to make clear the necessity of regular practice on this sound principle, if you wish to learn code. You have got to keep your mind constantly reminded at reasonable intervals of the the code letters and sounds, if you want to learn it within a reasonable length of time, and in closing we want to give you a few pointers on the best way to go about it:

1. Practice at least fifteen minutes a day or more *conscientiously* if you want to get results. The less time you spend on learning the code the longer it will take you to acquire speed.

2. Go about it with the idea in mind that you are learning something that will be useful, and will give you pleasure later.

3. Don't forget to accent the DAHS.

Practice on what we've given you until the next issue of RADIO AGE, when we will tell you just how and the best way to go about beginning to copy the amateur and other code signals; what systems the radio operators use in calling and talking to each other, and some of the abbreviations used over the air in radio code. Don't try to copy the code coming through the air until we tell you how—radio operators talk in a language almost their own, and you won't get any sense out of it. Watch for our instructions next month on how to handle the key, when we will tell you how to send properly, so that the most experienced operator will tell you that your fist is not "rotten." If you're with us, you are going to learn the code.

(*Note—Another interesting installment on how to copy code signals will be printed in the next issue of RADIO AGE. Don't miss it.—The Editor.*)

Greatest Show

Manager James F. Kerr was one of the visitors in New York during the radio exposition at the Grand Central there and he made a study of exhibits and show methods that will assist in putting on the big radio show which is to be held in Chicago at the Coliseum, beginning November 20. It is predicted by those in touch with the arrangements for this exposition that it will be the greatest ever held west of New York and it is likely to draw even greater crowds than attended the eastern exhibition.

Already entered in the prize contests for the most novel and for the best built homemade receiving sets are crystal detectors that you can carry in your vest pocket or under your hat; sets that are made from a handful of bailing wire, a few hairpins and a couple of tin cans; super-heterodynes with their nine and eleven tubes and a radius that takes in Ireland and Yap, sets that you can put on the horn of a cow so bossy will be entertained while the handsome dairy maid extracts the lacteal fluid.

There will be small sets concealed in dolls and woolly bears so that when baby is put to bed with her pet toy in her arms she can be lulled to sleep by the bedtime stories, or by a lecture on how hydro-electric power, properly distributed, will be the salvation of the farmer.

In the contest for novel sets, which is confined to school pupils in Cook County, the entries are limited to crystal and one-tube sets. For the best homemade set anything goes, and this contest has already brought entries from as far east as New Jersey and as far west as California.

The amateur sets will not have any monopoly of the novelty features, as middle west manufacturers are rushing through designs and patents for improvements and for new apparatus which will be exhibited for the first time at the Chicago show. Word from the New York show was that there was a dearth of new ideas there. That will not be the case here, it is declared.

Just one of the many big features of the manufacturers' exhibit section will be the new apparatus which is now being designed by E. T. Flewelling for the Buell Manufacturing Company of Chicago. H. H. Frost, who has taken the largest exhibition space in the show, will also have on exhibit for the first time some new ideas in radio.

Receiving Condensers

THE value of a good condenser in a receiving set is not always fully appreciated. The dielectric losses of a condenser are equivalent to adding a series resistance in the oscillating circuit. To add a series resistance in an oscillating circuit means loss of energy, with corresponding broadened tuning, and diminished signal strength. It is important that the losses in condensers be kept low.

In good condensers these losses are kept low by using only a high grade hard rubber for the solid dielectric. They are further diminished by using only a small quantity of this dielectric, and so placing it with respect to the electrostatic field that the dielectric hysteresis losses are kept at a minimum.

Don't buy a condenser that is constructed using a lot of insulation, and be careful to see that the insulation is not moulded mud.

If your newsdealer has sold out his supply of Radio Age you are likely to miss just the hook-up that you have been looking for. To avoid any such chance fill out the coupon in this issue and send in your subscription. Then you will be safe. And don't forget that with each subscription at the special price of $2.00 a year, or $1.00 for six months, we send you free the popular Reinartz Radio booklet FREE. Address Radio Age, 500 N. Dearborn Street, Chicago, Ill.

B-M

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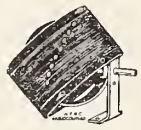

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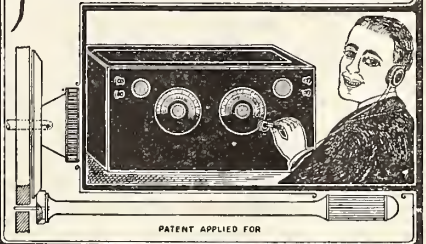

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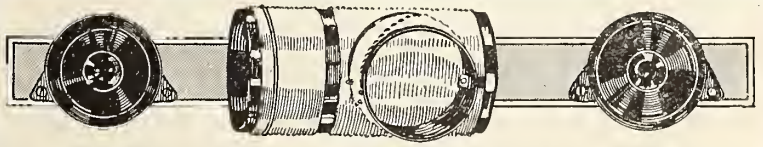

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The Erla Triplex Circuit

MANY of our readers have asked for a description of the new three-tube Erla Reflex circuit which seems to have created a great deal of interest among the fans lately, because of its ability to get the distant stations. The extreme sensitiveness of this set makes it possible to use an inside aerial, or a loop as desired, although much better reception may be obtained by using the former, which may consist of a single strand of wire stretched through the attic, or through several rooms. The principal advantage of the loop is its directional characteristics, which are not needed in the more sensitive reflex arrangement described.

It must be understood that the construction of this set cannot be carried on in a slipshod manner, but if the details given are carefully followed out to the letter, wonderful results may be expected. In this, as in other reflex circuits, the tubes do double duty, and the excellent results obtained are due to the fact that in doing double work, the three tubes will give the equivalent strength of six tubes used in the old way and this in connection with the crystal detector, should give range and selectivity which compares very well with a seven tube set.

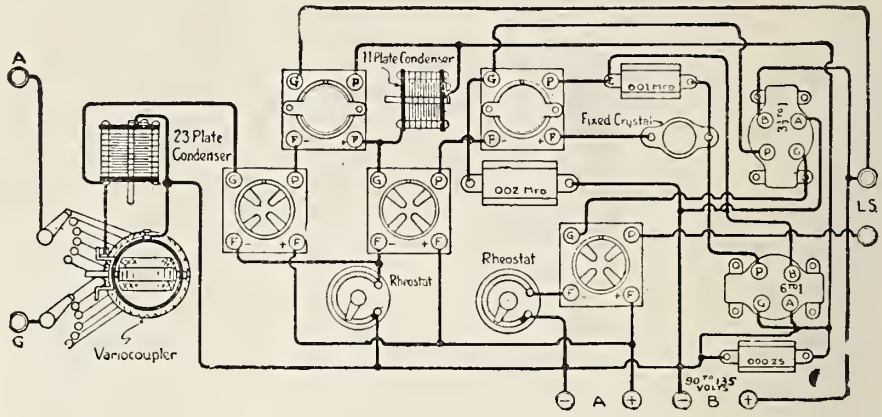
The Triplex circuit shown in the accompanying drawing can be easily traced from start to finish. The aerial is connected to one of the switch levers on the variocoupler, and the ground is connected to the other. The binding posts for the A and B batteries are plainly marked and are shown at the bottom of the drawing. The two posts on the extreme left are to be connected to the loud speaker. It will be noted that five sockets are shown, although only three tubes are used.

The extra sockets are used for mounting the radio frequency transformers, which are made for the purpose, but if other types are used, these extra sockets can be dispensed with, although for the best results, the reflexing transformers shown in the drawing, should be used.

The crystal used is of the fixed type and because of the greatly amplified current which passes through it, will be found to function very well and will never need adjusting. The audio frequency transformers should be of a type known to have the best of reflexing qualities. It must be stated here that all audio frequency transformers will not work in these sets and most of the trouble which one encounters in the construction of reflex sets, is due to this fact.

The values shown for the small fixed condensers must be carefully noted and any change in the capacity used at these different points in the circuit may mean failure. These values have been determined only by careful scientific experimenting and any substitution should be avoided.

The best tubes for this work are the C-301-A or the UV-201-A in the order named. C-299, or UV-199 may be used if desired, but the volume of the reproduction will be somewhat reduced.



Monitor Control

Washington, D. C.—The question of what monitor control is, seems to be worrying a number of radio fans, who try to keep abreast of the rapidly advancing art of radio communication.

Most of them know what remote control is, the expression itself practically indicating the method of operating a distant transmitter by land lines.

Monitor control is a similar method of receiving at a station removed from local electrical interference, and transmitting the signals by land lines to the central office. A radio engineer or expert radioman stands watch in the distant receiving station and sees to it that the receiving sets are tuned in and functioning properly during the reception of a message.

The Navy monitor control system, now used at San Francisco, San Diego and at the Radio Central in Washington, is a refinement of duplex operation. Three units, instead of one are operated: the transmitting station, the monitor receiving station, and the control or central operating office. This system is employed in the interest of efficient administration, rapidity of service and elimination of errors due to land wire relays, all activities being controlled at administrative headquarters or central office. Headquarters are frequently located where there would be interference from electric power lines or unfavorable atmospheric conditions for radio reception.

To overcome these difficulties, a monitor collecting or receiving station is established at a place free from all electrical disturbance. Signals are there received on overhead antenna or loops, and are impinged through suitable coils, on land wire loops, called "tone channels" composed of two land wire circuits between the monitor and the administration station, where the signals are transferred through suitable coils to the operator's head phones. By this method, operators are relieved of all functions except operating.

A large number of messages for simultaneous transmission and reception, including duplexing, can be handled, at the same time from administration headquarters. At San Diego, the monitor station is located at Point Loma, eight miles from district headquarters. All incoming signals are monitored from Point Loma to headquarters. All outgoing signals are sent from headquarters, the operator at headquarters controlling the transmitting key at the high-power transmitting station at Chollas Heights, twelve miles from San Diego by land wire.

The monitor station is located on the roof of the Navy Department in Washington, as little electrical interference in that part of the city is found.

New Coils and Condensers

It may be of interest to our readers to know that the Radio Instruments Company, of Chicago, Ill., is the manufacturer of the Cockaday coils already wound and ready to set up, and is also the manufacturer of seventeen plate condensers, to be used in the four-circuit tuner. The coils are neatly wound, the bank wound in particular. The makers of these coils claim them to be of low distributed capacity, and of close tuning properties.

The condensers embody a new principle in the way of a vernier, inasmuch as they do not use a separate plate for this purpose. This feature is allowed for by a closely adjusted cam, giving variations, which the manufacturer claims is not possible with the usual type. The use of the cam in connection with a special well designed pigtail connection cuts the losses in the condensers down to a minimum.

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Broadcasting Brings New Musical Era

By L. H. Rosenberg

PLANS for both improving Radio Station WBZ and initiating new ideas for broadcasting made by the Westinghouse Electric Company at Springfield, Mass., will make the station distinctive in the field of broadcasting. The new arrangements include radical changes in the method of broadcasting musical recitals and the introduction of lectures that will make the station unique in broadcasting circles.

Springfield is one of the most prominent musical centers of New England and although it is not generally known outside of the community, the number of musically inclined persons is proportionately greater than any other center in the country with the exception of Boston. In the past, the musical programs have been very similar to other radio stations throughout the country. The artists and musicians in the city and vicinity gave varied programs of instrumental and vocal music which brought forth generous applause from the radio fans from near and far.

These musical programs were arranged with due regard to the artist's ability and the needs of the radio station. It was firmly believed that these programs were the proper thing for broadcasting and the many letters received proved this point. As station WBZ was one of the first broadcasting stations in the country—it began operations in September, 1921—it was only natural that some pioneering had to be done.

As time went on, it was observed that although the music was appreciated, something was lacking in the presentation to assure its complete success. It might be stated in passing that after the first novelty of radio wore off, there was a great demand for more popular music. The directors of the station were firm in their belief, however, that a great amount of popular music would not stand the test of time and therefore classical music was made to predominate the program under protest from some of the radio listeners.

This belief in better music was strengthened by the comments that began to come in and the policy of broadcasting only good music was strictly adherred to. In fact, it appeared as if the public had begun to appreciate music and as far as radio was concerned, the demand for popular music had greatly diminished.

It is this condition that now confronts the radio station, and judging from the fans, the present policy could be continued indefinitely. But WBZ thinks that the present methods in their entirety are not adequate to make for permanent broadcasting and it is thus looking into the future, as it were, to anticipate the public's desire.

The public, or that portion of them who before the advent of radio, never heard a classical concert and therefore did not appreciate good music, are now becoming more and more interested in music. Although they are not trained in the art, they are beginning to appreciate music, and it is the natural feeling that they desire to know more about it.

For this reason, WBZ is planning to give music in such a manner that the public will come to know music. Courses in music, written so the lay public can understand them, will be given with illustrations of the music talked about. In other words, a study of music will be made by the public from both the viewpoint of the composer and the elements of the art with illustrative interpolations.

This will not be done in miscellaneous talks but will be given in a series of lectures that will give the interested radio fan a complete course in music. It is thought that this plan will add a new impetus to radio music by the radio fan and will do much to hold his interest in radio.

It has been the practice of radio stations in the past to allow magazines and other agencies to broadcast miscellaneous material which may or may not be of interest to the radio listener. Most of the material broadcasted was given by persons who had a selfish purpose in giving it. They either wished to advertise themselves or their business. The material that they broadcast was, therefore, more or less indirect advertising and the public was always aware of this fact. They said, however, that is, most of them, that as they were getting the material free of charge that "beggars cannot be choosers" and were satisfied with the broadcasts. The broadcasters have found it rather difficult to make a good selection of the material, and often incorrect statements would slip into these talks.

The speeches by prominent personages, however, always were well received, but the majority of stations were not able to obtain such persons every night in the week.

Therefore, they used material thrust upon them by people wishing to further their own interests often with sad consequence. The matter was inflicted upon the radio audience and many times brought an avalanche of protests. In this connection, however, there is invariably two sides to the story. Every time that some people complain about a broadcast, there are always other persons who praise it. This, it might be said, is one of the main troubles of the broadcasting director. There is always the pro and con to be considered on cases in dispute.

In view of the great number of miscellaneous addresses that are thrust upon the public, it is thought by WBZ that it might be a good idea to go to the other extreme and broadcast only a series of lectures. Heretofore, this policy has been restricted because of the unreliability of radio for distant purposes.

Radio, at this time, surely, should be advanced to such a state that difficulties of interference and nonreception within a reasonable distance from the station, are not present. If these problems have not been solved to the highest degree, their solution will come more quickly if a definite interest to listen in on certain occasions is manifest.

In view of these conditions Station WBZ intends, for fall and winter broadcasts, to initiate continuous events. This will be done to motivate the program and assure the constant listening in of radio fans within constant hearing distance of the station.

Take, for instance, the course in "The Art of Writing Short Stories." This department will be conducted by Dr. J. Berg Esenwein, of the Home Correspondence School. Dr. Esenwein is well-known throughout the country for his courses in journalism and is considered one of the best authorities on the subject. For a number of years, he was editor of Lippincott's Magazine, which went out of existence shortly after he resigned the editorship. Dr. Esenwein has prepared a series of ten lectures on short story writing which will not be given merely as detached informational talks, but in such a manner that they will have the definite purpose of teaching the listeners interested in the subject. The course will be given at periodic intervals and at the end of the course, radio fans who would try their hand at writing will be invited to submit stories. The best stories that are written along the lines suggested by Dr. Esenwein will receive prizes.

It is thought that this course will maintain interest in the lectures, as there will be a definite goal at the end of the course.

In the same manner it is planned to give courses in economics, psychology, English, literature and many other subjects. Each course will have a definite object and the radio students will receive a reward in college credits or otherwise recompensed.

An arrangement has been made with the Northwestern University, a prominent evening school in New England, whereby these courses will be given by some of the foremost professors of this part of the country; also, arrangements are under way with Massachusetts State Extension Department for courses especially adapted to the interest of women and girls.

Although many of the plans are in the making, a complete system will soon be laid out to fit the needs of a New England broadcasting station to render the best possible service to the radio audience. WBZ is of the opinion that these efforts will bring renewed and continued interest in radio broadcasting. After a few years of experimental broadcasting to try to analyze the needs and desires of the radio fans, it is now time to put the stations of the country on a real utilitarian plan so that the greatest number of people may benefit from the great expenditure of time, money and energy that is being placed on broadcasting.

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500 N. Dearborn Street **Chicago, Ill.**

Radio on the Rifle Range

By CARL H. BUTMAN

Washington, D. C.—Radio, or its half brother, wired-wireless, will be used very soon on big national rifle ranges between the firing lines and the target pits as a substitute for line telephone systems.

Results of recent Signal Corps tests during the National Rifle matches at Camp Perry, Ohio, have demonstrated that a wired-wireless system will cost only a third the money required to install and operate a regular telephone system. In addition, the new system would last several years longer than the present field telephone service, which usually requires replacement every three years.

On this range with 100 targets, 1,100 men fire in three hours' time, and about seventy-five men, one for each ten targets, were required by the Signal Corps to maintain telephonic communication between the firing points and the butts where the targets and the markers are located. The initial cost of the complicated equipment is approximately $35,000 and the annual upkeep, including personnel, amounts to about $11,000. Usually, the whole range from 200 to 1,000 yards, is being fired at the same time. The markers have to pull each target down, find the hit, if there is one, and mark it.

This is done by pasting a paper sticker over the bullet hole, hoisting the target and indicating with one of three large disk markers where and what the hit was. When the men fail to so mark a target, believed to have been hit, the range officer has to call up the proper pit on one of several phone lines and order the target re-examined and marked. It is easy to see that this entails considerable bell-ringing, answering and conversation over regulation phone circuits.

The new system planned and laid out by Captain H. W. Webber, of the Signal Corps, eliminates considerable time, work and complication. With a field radio transmitting set, five loud speaker receivers and a little wire, he conducted a most satisfactory test for the National Rifle Association and the army at Camp Perry during the last days of the recent matches.

When a target was not pulled down, he spoke into the transmitter on the firing-line, saying, for example, "Mark 21," or "Mark 67," which would be at least 200 feet from No. 21. All along the line of pits the five loud speakers announced his order, and No. 21 or No. 67 came down and was marked promptly. Those in the pits not concerned with the numbers called paid no attention.

The cost of a wired-wireless system to replace the almost worn out equipment at Camp Perry is placed at $12,000, and the maintenance with about twenty-five men is estimated at about $4,000, for the period of the national rifle matches. These figures, while estimates only, show an initial saving of $23,000 in equipment and about $7,000 for labor, not to mention far longer life of the wired-wireless equipment and the ease of putting it up and taking it down in the severe winter months when the range is closed.

Pick-Ups of Hook-Ups

(*Continued from page 20.*)

KDKA, WIP, WOO, WFI, WDAR, WCAP, WSAI, 8XB, WDAP, WJAX, WJAZ, WSB, WLAG, KSD, WAAM, WFAA, WBAK.

I finished up about 3:20 a. m.! Pretty good catch, don't you think? Will try for a better list some time soon, and let you know about it.

Yours very truly,
GEORGE W. JEFFERS.

Open the window—we want to throw our chest out. Mr. Jeffers ought to get Mars when he tries out the super heterodyne circuit of this issue. The fact that all of the foregoing circuits were printed during the summer goes to show that the only way to get results is to "Let Our Hookups Be Your Guide."

Dr. R. L. Barnheardt, of 212½ West Main Street, Spartanburg, S. C., wants to pass on some first rate information concerning the Hopwood circuit to our readers:

RADIO AGE.
Gentlemen:

I am sure that BCL's who have been using the Hopwood circuit as described in the July RADIO AGE, page twenty, will be glad to know that they can improve their sets by making a few additions as shown by the enclosed drawing.

In making the changes, be sure to place the rotary plates of the 11-plate condenser to the lead going to the phones, and also to place the fixed condenser as shown.

Very truly yours,
DR. R. L. BARNHEARDT.

(The suggested changes in the circuit, as made by Dr. Barnheardt, are shown in Figure 1. We would be glad to forward any letters telling of results obtained by these changes to the above contributor.)

This concludes the Pickups By Readers section for this issue. RADIO AGE would be glad to have lists of stations heard by our readers, and any other information which would prove interesting. Address communications to the RADIO AGE, Pickups by Readers Department, 532-500 North Dearborn Street, Chicago. This is the Pickups by Readers Department of RADIO AGE signing off, wishing you a happy Thanksgiving.

EEEUUURRK.*

(*Business of shutting off generator.)

Inductance Coil

(*Continued from page 25.*)

individual strand should be continuous throughout the entire length of the cable and each strand should be insulated from every other strand throughout the entire length. As to the size of the wire it would seem that, for mechanical reasons, the wire should not be much larger than No. 18 (B & S). This limitation permits of the use of high-frequency cable as large as forty-eight strands of No. 38 wire.

British Radio

Recent statements of the British Postmaster General indicate that a solution has been found to the problems connected with the establishment of the British Empire wireless chain, says Consul General Skinner, London, in a report to the Department of Commerce. Not all points connected with the issuance of wireless licenses have been disposed of, but there is every indication that the government has adopted a policy which will permit private radio companies to establish high-power stations both in the United Kingdom and in the colonies. At the same time the Post Office will proceed with its own plans for a highpower station at Rugby.

The private interests which have applied for licenses are the Marconi's Wireless Telegraph Company, Limited, and the Eastern Telegraph Company, the latter being the largest unit in the British cable system. The Marconi Company has contracted with the Union of South Africa and the Dominion of Canada for high power radio stations designed to communicate direct with England, and is associated with the Amalgamated Wireless which has a similar contract in Australia.

The Eastern Telegraph Company is the first cable concern of any size to take up radio transmission as an adjunct to its cable service.

The arrangement reached by the post office with the Marconi Company is believed to be unique in the history of telegraph operation. The telegraph services of the empire are to be conducted by the wireless pool, consisting at present of the Marconi Company and the post office, although it seems certain that the Eastern Telegraph Company will be taken in at a later date should its plans for stations in India and China meet with success. The wireless stations necessary for the proposed imperial service will be furnished in certain agreed proportions by the two parties to the contract, the company furnishing two stations in the first instance and the government one.

The position of the government in the communication field is greatly strengthened by the consummation of this agreement and it is probable that the approaching coordination of land telegraphs, international radio, and submarine cables will form a worldwide system of communications for the British Empire that will result in very effective government control of the whole field.

"Schenectady Gives the English a Kick"

(*Continued from page 23.*)

result of the WGY $500 prize contest will be put on, the winning play being featured. Many other especially prepared radio dramas will be produced, several of which will have their initial performance at WGY.

Edward H. Smith, director of the players, with the assistance of engineers, carpenters, etc., is planning and constructing new devices allowing the more vivid representation to the radio fan of new scenes and actions. One of these novelties will be a horse race.

ADVANCE OF THE GRAND ARMY

NAPOLEON'S name fills more pages in the world's solemn history than that of any other mortal. The advance of his Grand Army into Russia is the turning point of his career and marks the beginning of his downfall. During the World War mighty armies marched over the battlefields where Napoleon fought over a century ago. All the causes of this mighty struggle may be learned from the pages of history. The one complete, accurate, authoritative and reliable history, depicting the rise and fall of every empire, kingdom, principality and power, is the world-famed publication,

Ridpath's History of the World

Including a full authentic account of the World War

Dr. John Clark Ridpath is universally recognized as America's greatest historian. Other men have written histories of one nation or period—Gibbon of Rome, Macaulay of England, Guizot of France; but it remained for Dr. Ridpath to write **a history of the entire World** from the earliest civilization down to the present day.

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We will **name** our **special low price** and **easy terms** of payment only in direct letters. A coupon for your convenience is printed on the lower corner of this advertisement. **Tear off the coupon, write** your **name** and **address** plainly and **mail** now before you forget it. We will mail you 46 free sample pages without any obligation on your part to buy. These will give you some idea of the splendid illustrations and the wonderfully beautiful style in which the work is written. We employ no agents, nor do we sell through bookstores, so there are no agents' commissions or book dealers' profits to pay. Our plan of sale enables us to ship direct from factory to customer and guarantee satisfaction.

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RIDPATH takes you back to the dawn of History, long before the Pyramids of Egypt were built; down through the romantic troubled times of Chaldea's grandeur and Assyria's magnificence; of Babylonia's wealth and luxury; of Greek and Roman splendor; of Mohammedan culture and refinement to the dawn of yesterday, **including a full authentic account of the World War.** He covers **every race, every nation, every time,** and holds you spellbound by his wonderful eloquence.

Endorsed by Thousands

RIDPATH is endorsed by Presidents of the United States, practically all university and college presidents, and by a quarter of a million Americans who own and love it. Don't you think it would be worth while to mail us the coupon and receive the 46 sample pages from the History? **They are free.**

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RIDPATH pictures the great historical events as though they were happening before your eyes; he carries you with him to see the battles of old; to meet kings and queens and warriors; to sit in the Roman Senate; to march against Saladin and his dark-skinned followers; to sail the southern seas with Drake; to circumnavigate the globe with Magellan. He combines absorbing interest with supreme reliability.

THE RIDPATH HISTORICAL SOCIETY
CINCINNATI, O.

FOLD HERE, TEAR OUT, SIGN AND MAIL

FREE COUPON

THE RIDPATH HISTORICAL SOCIETY
Cincinnati, O.

Please mail, without cost to me, sample pages of **Ridpath's History of the World,** containing photogravures of The Surrender at Sedan, Napoleon, and other great characters in history. Also write me full particulars of your special offer to **Radio Age readers.**

NAME .....

ADDRESS .....

RADIO AGE INSTITUTE

To insure 100% value to readers of advertisements, as well as 100% value to the advertisers themselves, radio equipment is now being tested and endorsed by the

RADIO AGE INSTITUTE

500 NORTH DEARBORN STREET
CHICAGO, ILLINOIS

No charge is made for testing and approval, and all merchandise will be returned as soon as possible, transportation expenses to be paid by the manufacturer. Lists of makers of approved radio goods will be published from time to time.

SERVICE DEPARTMENT FOR READERS

Please remember that Radio Age has one of the best radio instructors in the United States, who is ready to answer any technical question. This costs subscribers nothing.

RADIO SENSATION OF 1923

Erla Receivers out-distance all other sets with an almost unbelievable volume and a naturalness that cannot be distinguished from the source of reception.

This is the famous Erla Reflex Hook-up. Less than one year old—but has taken the entire nation by storm. Every listener-in raves about it and wants a set of his own immediately.

So easy to construct that anyone who can handle a screw driver can build the set complete in a surprisingly short time—about 1 1-2 hours. Everything is so simple and easy.

NO SOLDERING WHATEVER—ONLY A SCREW DRIVER NEEDED.

One tube hook-up makes set equal to any other two tube set ever invented. Erla two tube set equals four tubes of the best of other hook-ups.

Erla three tube hook-up has no equal up to seven tubes of other sets. This hook-up brings in the most distant stations with a volume equal to powerful local stations. In volume this hook-up equals that of any seven tube set ever devised. And for naturalness of tone has no equal in any other set of any number of tubes. The results from the Erla 3 tube is naturalness itself and cannot be improved upon. Actual size working diagrams make every thing simple and easy.

Every piece of apparatus and every wire is pictured in it's exact place—every article needed is listed on the diagrams.

With such wonderful results to be obtained from an Erla hook-up at a very low cost you cannot afford to waste time and money building other sets that cannot possibly begin to equal Erla hook-up performance.

Diagrams sent same day your order is received. Send P. O. or Express Money Order or Bank draft or Bank Cashier's check. Do not send stamps or personal checks.

Erla Hook-up Diagram Prices

3 sheets for making 1 tube set 25c
3 sheets for making 2 tube set 35c
3 sheets for making 3 tube set 50c

FRANK D. PEARNE

Sole Distributer of Erla Diagrams for U. S. and Canada

829 Waveland Avenue, Chicago, Ill.

Mexican Show

Mexico has had its first radio show. It has been a most popular and successful show, which could out of sheer brilliancy and beauty compare with some of the best radio shows in the United States last winter.

The show was held in the "patio" of the School of Engineering in Mexico City. Booths were installed about the court, and in the center portion the "Casa del Radio"—the Home of Radio was built. Many firms, including the Siemens Company, Hubbard & Bourlon, J. M. Velasco, R. L. Azcarraga, Beers Electric, and Westinghouse Electric, placed on exhibition in attractive booths some of the most modern radio broadcasting equipment available.

The exposition was officially opened by President Obregon, of Mexico, and was the occasion of extensive ceremonies and celebrations. Accompanying the president were members of the cabinet, prominent officials, and engineers, and M. Rolland, of the Radio League of Mexico.

During the show, which lasted ten days, there were many unusual features. Among these were brilliant balls, attended by representatives of the government, officials, and prominent society senoritas. A contest among amateurs for the best homemade radio set was staged, the prize going to two young boys of Mexico City. Daily broadcasts were sent from The Home of Radio, one of the most popular announcements being those which were sent out during the Firpo-Hibbard fight, which took place in "El Torso."

Finally, prizes were given to the various booths of the exhibitors, the first prize being awarded to the Westinghouse Electric Company. At the time of the distribution of the prizes, Mr. Rolland, an officer of the Radio League of Mexico, made a plea for the extension of radio activities in Mexico, and suggested that the Secretary of Commerce appoint a commission to study the situation from all angles. The broadcasting service in Mexico is entirely inadequate, the broadcasts picked up being mostly from stations in the United States.

Connections of Unmounted AF Transformers

IN ORDER to obtain the best results from an amplifying transformer, certain precautions should be observed. Since what is wanted is the production of the maximum potential, or rather the change of potential on the grid of the amplifying tube, it is best to connect the grid to the outside terminal of the secondary of the transformer. This is because the outer portion of the secondary has smaller capacity to ground than the inner portion, due to the proximity of the latter to the primary winding, which is connected to the filament and other low potential parts of the circuit. This capacity effect increases with frequency, and therefore reduces the intensity of high notes proportionately more than low ones, thus tending to cause distortion. Howling or oscillation at audio frequencies is caused by coupling (either electrostatic or magnetic) of the amplifier grid to some other part of the circuit, and is more troublesome with two or more stages of amplification than one. If the electrostatic and magnetic couplings are made to oppose each other the tendency to oscillate is minimized, and when a transformer is connected into a circuit it is worth while to reverse the leads to the primary to see which connection is better. In some cases the oscillations are above audibility, but the strength of signals is reduced, nevertheless.—Bulletin 916, General Radio Company.

Radio in China

China will soon have five commercial radio stations and may develop broadcasting also, according to information received in Washington. Contracts have been signed for a high-power station, similar to the French Lafayette Station, to be built at Shanghai, and four others of lower power to be located at Pekin, Harbin, Canton and Shanghai. They will be built by the Federal Telegraph Company. The last four will serve as feeders for the big Shanghai trans-Pacific station.

Four attempts to establish radio broadcasting in China have been made at Shanghai, and although one fifty-watt set is still in operation the right to continue is questioned by the Chinese Ministry of Communications, Trade Commissioner Smith advises the Department of Commerce.

The first effort to institute modern broadcasting was made by the Radio Corporation of China from a set on the roof of the Robert Dollar Building; but the scheme was shortlived. A little later the Electric Equipment Company installed a fifty-watt set on the top of its building on Nanking Road, ostensibly for experimenting and for demonstrating radio sets for its customers. This station is still operating. Broadcasting programs were next offered to the public by the Shanghai Evening News, and recently the Wing-On Co., Ltd., a large department store, installed a station.

Broadcasting development in China is said by the United States Commissioner to have been retarded by the fact that the importation of wireless apparatus was prohibited by the Chinese government in March, 1923. This embargo was based on an earlier mandate which stipulated that all telegraphs and telephones, whether wire or wireless, were electrical communications and as such should be operated solely by the government. An organization known as the Shanghai Amateur Radio Society has been active with propaganda for radio for the past few months but little success is reported.

Readings by Radio

Rev. Claude J. Pernin, S. J., has resumed his regular Thursday night "Twenty Minutes of Good Reading," from Westinghouse Station, KYW. This feature was discontinued for several weeks while Rev. Mr. Pernin was out of the city.

This feature consists of the dramatic interpretation of short stories, poems, passages from recent books and other literary selections.

Rev. Claude J. Pernin, S. J., is Professor of English literature of Loyola University, Chicago, and has conducted courses in English for this University for the past five years. He has given courses in the art of the short story, Shakespeare, Tennyson and Browning and the novel, as well as courses in public speaking.

Reinartz Book FREE

Reinartz Radio Book with Hook-ups—best book on best circuit —written and illustrated by Frank D. Pearne. If you want one free, fill out the coupon.

RADIO AGE,
500 North Dearborn St.,
CHICAGO.

Please send me FREE one of your Reinartz Radio Books and send me Radio Age for ..... I want to take advantage of this Special Offer. I enclose .....

Name.....

City.....

Street and Number.....

More Real Radio
For Less Real Money

RADIO AGE increases its number of pages this month but instead of increasing its price it offers a *reduction* in its regular subscription rate.

More pages in Radio Age mean more of our excellent circuit diagrams, more of our timely instructions, clearly written by experts, on how to build sets and how to operate them.

More helpful hints to radio experomenters; more illustrated answers tm questions; more published letters fro readers who have discovered new kinks;

Month by month we are printing more and better radio information *and we print nothing else* but radio. If you have been reading Radio Age you know that we printed the best drawings and circuit diagrams of the Reinartz, Kaufman, Grimes, Erla and the Four-Circuit systems that have been published. We are going to keep up that sort of practical trail-blazing.

Each month we correct our complete list of United States and Canadian broadcasting stations. You will find such a list a pleasure when on fishing expeditions for the far stations.

Despite all this we are making you *this special offer:* We will send you Radio Age for one year for $2.00, or for six months for $1.00 if order is accompanied by coupon.

Newsdealers may fail you. For 16⅔ cents a month you can make sure of getting your magazine on the dot.

(This offer will be withdrawn on December 1, 1923.)

THIS COUPON SAVES YOU MONEY

Radio Age, Inc.,
500 North Dearborn Street,
Chicago, Ill.

Please enter (renew or extend) my subscription to Radio Age for

One Year at $2.00
Six Months at $1.00

This gives me the bigger and better magazine at a reduction over the old rate and insures my getting the magazine promptly each month. I enclose $2.00 (money order or currency by registered mail). If by check I add 5 cents for exchange.

(No additional cost to Canadian subscribers. Foreign $1.25 for six months; $2.50 for one year.)

Name.....

Address.....

.....

Turning on Our Loud Speaker

IN HIS editorial of the October issue, the Editor might have told you more about what readers thought about RADIO AGE, and the matter printed in this magazine, when he turned on the loud speaker but space did not permit. He was able to broadcast only one specific expression of appreciation.

We want to (modestly) tell you a little more about what people write us, and what they think, while we have the loud speaker going.

We pick out the letter of Herbert E. Schlueter, of Canistoba, South Dakota, as a typical boost given RADIO AGE by many readers, when he says:

> "I have been a reader of the RADIO AGE for a long time, and I like it very much. I have built several sets according to instructions printed in RADIO AGE, and think they are fine business."

The letter of O. Keith Baldwin, of Bridgman, Michigan, is a type of many from readers who have found the value of this magazine, as a source of real, practical information concerning broadcast reception. He says:

> "Enclosed you will find a check, for which please extend my subscription to the RADIO AGE for one year. I believe this speaks my regard for your wonderful little magazine better than any words I might say."

In our correspondence files we have letters from fans who have cultivated that "Let Our Hookups Be Your Guide" habit to a degree. Let the following letter explain:

RADIO AGE,
Gentlemen:

I failed to receive my copy of RADIO AGE for September. I had almost as soon miss my pay check as RADIO AGE, so please mail me a copy as soon as possible.

Very truly,
J. H. JONES.
Crestwood, Ky.

Advertisers, please notice. Here's a letter from a man who makes advertising his business, and who evidently knows the value of reader interest in a good radio publication:

RADIO AGE.
Gentlemen:

Thank you very much for the information you sent me the other day. I am going right ahead with the amplifier, and if it is any satisfaction to you to know it, will confine myself as far as possible to parts advertised in RADIO AGE.

My original hookup (Reinartz detector) was taken from your pages of the May issue, and it has worked very satisfactorily.

Thanking you again, I am,
Very truly yours,
R. W. CLASSEN.
Chicago, Ill.

One reader tells us that he bases his decision as follows:

> "I have been buying your magazine at news stands in Moline, Rock Island and Davenport, and I think it is among the best, if not the very best magazine devoted to the radio experimenter that comes to my notice. Believe me when I say that I am judging pretty closely, because all magazines of any worth at all come under my scrutiny. They all come to my reading table, so you see I speak from experience, and to justify my contention, I am going to subscribe to RADIO AGE and make it come to me regularly."

Now that's a pretty nice compliment, and if weren't too busy making up a better book for you next month, we would probably turn a 75-turn handspring.

Harry E. Johnson, of 1111 East 62nd Street, Chicago, Ill., writes us:

> "I have just become a member of your RADIO AGE family, being a disciple of your technical editor, Mr. Pearne, and I hope it will be the largest radio magazine in the game some day. I have followed Mr. Pearne's instructions, and find with joy that RADIO AGE is the only place I can get them regularly and with certainty."

Thanks, Mr. Johnson. We'll show that to Mr. Pearne. He has many fellows who have profited by following his teachings, and we know he feels great when he hears that they appreciate his information.

We are the recipients of many letters commenting on the method of presenting circuits and ideas, a good sample being the following extract taken from a letter from Martin A. Zeiger, of 45 West 18th Street, New York City:

> "I read with great interest your article and drawings on the three-tube Grimes Inverse Duplex, which appeared in one of the recent issues of RADIO AGE, the article by Frank D. Pearne, and the clear drawings by Felix Anderson.
>
> "May I compliment you on these isometric drawings, which are a great help to 'radio nuts' such as myself, as they eliminate any doubt as to panel layout, or connections."

When we exhibited the above letter to Mr. Anderson, our engineering draftsman, he got so worked up that he chewed the corner off his drawing board. HI!

Leonard Madsen, of Sioux City, Ia., says:

> "I have had a few of your magazines, and they are fine."

After Mr. Madsen has read about two more issues, he will get something like Mr. Jones, of Crestwood, Ky., and feel about as lost without RADIO AGE as a traffic cop who has just swallowed his whistle.

J. H. Hoffman, of Chicago, Ill., wrote us for information some time ago, got it free of charge because he was a subscriber, and then after he had worked out the information given him told us:

> "I wish to thank you for the information on the Armstrong circuit which you so kindly sent me, and want to tell you that I am getting very good results; I had TWELVE outside stations the first night I tried the set!"

Before we turn off the loud speaker we want to tell you that all the above letters were unsolicited, and we print them to show our readers how this magazine is received. For the fellow who is not a reader of RADIO AGE, we print them to demonstrate the value of cultivating that "Let Our Hookups Be Your Guide" habit.

Mexican Station

A powerful radio broadcasting station has been inaugurated in the Mexican Federal Capital, Trade Commissioner McKenzie reports from Mexico City.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912.

Of Radio Age published monthly at Mount Morris, Illinois, for October 1, 1923.
State of Illinois } ss.
County of Cook }

Before me, a Notary Public in and for the State and county aforesaid, personally appeared Frederick A. Smith, who, having been duly sworn according to law, deposes and says that he is the editor of the Radio Age and that the following is, to the best of his knowledge and belief a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher Radio Age, Inc., 500 N. Dearborn St., Chicago; Editor, Frederick A. Smith, 500 N. Dearborn St., Chicago; Managing Editor, Frederick A. Smith, 500 N. Dearborn St., Chicago. Business Manager, M. B. Smith, 500 N. Dearborn St., Chicago.

2. That the owner is: (If the publication is owned by an individual his name and address, or if owned by more than one individual the name and address of each, should be given below; if the publication is owned by a corporation the name of the corporation and the names and addresses of the stockholders owning or holding one per cent or more of the total amount of stock should be given.) Radio Age, Inc., Frederick A. Smith, 500 No. Dearborn Street, Chicago, Ill.; John H. Lohbeck, St. Louis, Mo.; M. B. Smith, 500 North Dearborn Street, Chicago, Ill.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the six months preceding the date shown above is..... (This information is required from daily publications only.)

FREDERICK A. SMITH,
(Signature of editor.)

Sworn to and subscribed before me this 8th day of October, 1923.

HARRIET DILLON
(My commission expires June 7, 1927.)

Reinartz Radio

How to make this distance wrecker.
How to amplify it.
How to make a Reinartz panel.

With Hook-ups

Written and Illustrated by
FRANK D. PEARNE
Chief Instructor in electricity at Lane Technical High School, Chicago, and famous writer on radio construction and operation.

Experts agree this Reinartz Hook-up is best for average fan.

Hook-up for the Long Distance Crystal Set—They are all trying it.

This book has helped thousands

Published by
RADIO AGE, Inc.
500 N. Dearborn Street
CHICAGO

AT YOUR NEWSDEALERS' OR SEND MONEY ORDER OR CURRENCY TO PUBLISHER

Price 50 cents

This booklet free with each yearly or six months subscription order. See coupon in this issue.

Why Donald B. MacMillan Chose the Zenith

The great hardship of the Arctic is not cold but solitude. MacMillan had seen men crazed by the terrible North Pole isolation.

Radio could break the awful spell of the ice-fields. But with the success of his expedition at stake, none but the most powerful long-distance set obtainable would answer. Captain MacMillan chose the

ZENITH
TRADE MARK

Results justify his choice.

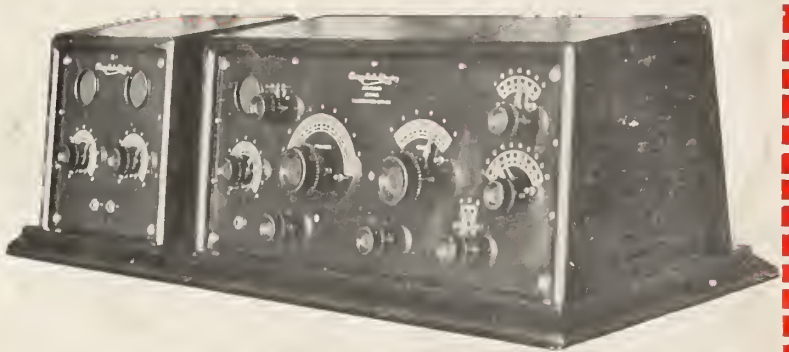
Every week a message is being broadcasted from the Zenith Edgewater Beach Hotel Broadcasting Station, Chicago, to the men of the staunch ship Bowdoin, frozen into the ice 11 degrees from the Pole.

And by Zenith wireless, Captain MacMillan sends his messages back to civilization. He reports that he and his crew are listening not only to messages and music from Chicago but even from Havana, Cuba and from Honolulu!

Thus is new history being made; and the supremacy of the Zenith in the field of radio, which was established by the Berengaria test, is being made even more out-standing by these new adventures of the Zenith in the Frozen North.

Zenith Radio Corporation

332 South Michigan Avenue, Chicago, Illinois



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ZENITH RADIO CORPORATION,
332 South Michigan Avenue,
Chicago, Illinois

Gentlemen:—Please send me illustrated literature on Zenith Radio.

Name.....

Address.....

City.....

State.....

RADIO AGE

The Magazine of the Hour

Price 25 cents

DECEMBER 1923

Station XMAS

IN THIS NUMBER

Building the Haynes Receiver
By Frank D. Pearne

How to Make a Combined Amplifier and Loud-Speaker
By Carl Masson

Learning the Code
(Second Article)
By Felix Anderson

What the Broadcasters Are Doing

Complete Corrected List of Broadcasting Stations

More Good Circuits

Let Our Hook-ups Be Your Guide

Tune In On This Christmas Idea!

GIVE him 24 months of high-class radio reading and instruction in his favorite hook-up magazine. He knows our circuit drawings are the best in the United States because he has been buying our periodical on the newsstands. He knows our technical articles are the best because he and his friends have tested them for two years and found them true as a trivet. He knows our list of broadcasting stations is complete EACH MONTH and CORRECTED each month, because he has been using our list when fishing for far stations. He knows our department for letters from readers is a radio education in itself.

Then why not save $1.50 and send him RADIO AGE for two years at practically the price of one year?

There is a refinement of radio value in Radio Age that has earned for it the affectionate title of "Old Reliable." Therefore, when we offer you this magazine

TWO YEARS FOR $3.50

we have helped you solve a Christmas problem. Send us the coupon, accompanied by remittance. We will send him the Christmas number, with special Christmas cover, and twenty-three good numbers thereafter. Or send us two names and $3.50 and we will mail Radio Age to each of them for one year.

(This offer will be withdrawn on January 1, 1924.)

Station XMAS Signing Off

I WANT THIS CHRISTMAS BARGAIN

RADIO AGE, Inc.,
500 North Dearborn St.,
Chicago, Ill.

Please send your bigger and better Magazine for

TWO YEARS at $3.50
ONE YEAR at $2.00

To the address given below. This saves me $1.50 from the regular subscription price for two years or fifty cents from the old price for one year. It also insures getting the magazine each month, even though newsdealers sell out early. I send by money order, or registered mail currency. No additional cost to Canadian subscribers; foreign subscriptions, fifty cents additional.

Name.....

Street.....

City and State.....

RADIO AGE

The Magazine of the Hour

(Established March, 1922)

Volume 2 *DECEMBER 1923* *Number 11*

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Junior Heterodyne

ONE of the best writers on radio subjects has prepared an article for our January issue which is entitled, "The Junior Heterodyne." It will be illustrated with some of those drawings which have won this magazine a great following and which have induced some other periodicals to try to emulate us. More power to you, brothers, it is all for the good of radio.

We shall also offer an interesting article on simple experiments in radio control. Something that will appeal to the inventive reader.

In this issue we are publishing a newly revised list of broadcasting stations with the wave lengths. This is a new list, received just before going to press, and was obtained from the United States Department of Commerce. This list is as complete and correct in every detail as can be obtained and we believe it will justify the expense and labor devoted to it. Please remember that it is not the list "authorized last August" but this week's—today's—roll of broadcast stations.

If you want to have the next issue of RADIO AGE sent to you free, or if you want one number added to your subscription period, find an error in the list and tell us about it. We want you to kick about it, if you find something to kick about. That applies to every department of the magazine.

May we modestly call your attention once more to the quality of the draftsmanship devoted to producing your isometric diagrams? A new artist in this line joins our staff in the next issue.

If it appears in RADIO AGE, it is *original* and it is *dependable.*

Let our hookups be your guide.

Frederick Smith

—Editor, RADIO AGE.

Radio was the chief element in electing Senorita Carmen Fernandez Ramos, the most beautiful girl in Cuba. The campaign conducted by Radio was heard in both the United States and Canada. Story on page 31.

RADIO AGE
"The Magazine of the Hour"
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A Two-Step Amplifier and Loud Speaker Combined

By Carl Masson
Illustrated by Felix Anderson

EVER since broadcasting stations have been in operation, radio has been the ideal source of entertainment in many a family circle. The broadcast programs for this winter promise to be unusually interesting and to get the full pleasure of them, a two-step amplifier and a loud talker would be a worth while addition to any single tube outfit. The author describes herewith a combination of the two, which the average radio man can construct at home with a few tools, plus a little work.

The cabinet is the first thing to consider. This may be made of most any kind of wood about three-eighths inch in thickness. I have found that for some reason or other amateurs very rarely work to given dimensions, and therefore I have decided to omit them, leaving them to the constructor's own judgment according to various conditions. I would suggest as overall dimensions, 16 inches in height, 12 inches in width, and 12 inches from front to back.

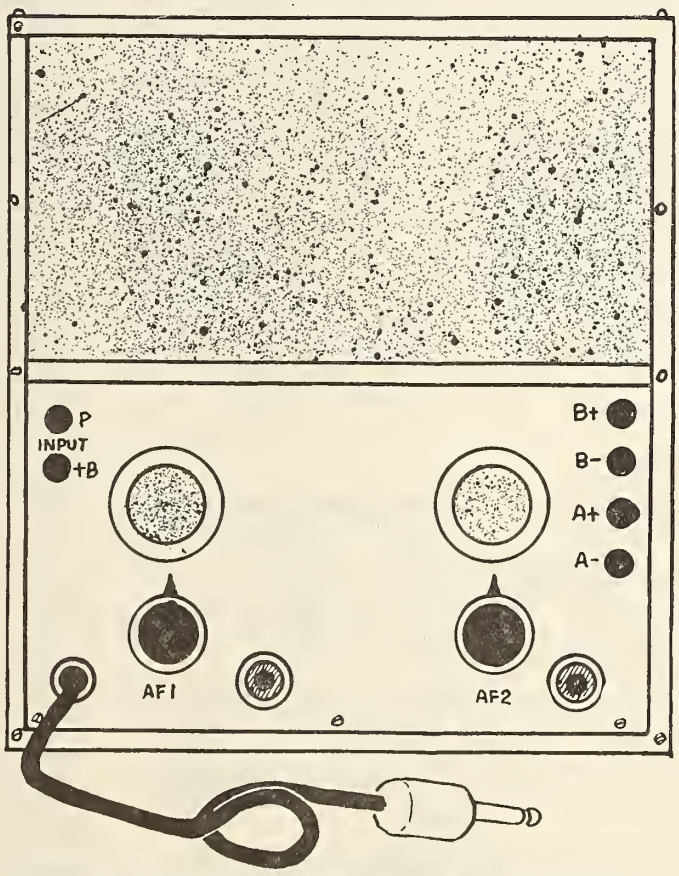

Figure 1. This is the front panel view of the neat-appearing, loud speaker and two-stage amplifier, described by Mr. Masson.

Tin Horns

After the cabinet has been assembled, the loud speaker comes next in consideration. In spite of the failure demonstrated by the application of the tin horn to the phonograph, some manufacturers of loud speakers still use tin for their horns. Tin horns yield tinny sounds. As one manufacturer has put it: "Would you make a violin out of tin?" What a big difference the wood horn made in the phonograph! The wooden horn also makes an equal difference in radio, because of the rich, mellow and undistorted tone derived from it.

The loud speaker occupies the upper half of the cabinet, as shown in the drawings. It should be made of some kind of hardwood so as to get clear, true tones. It consists of four pieces of wood, shaped as shown in the drawings. The size depends upon the dimensions of the cabinet, and the entire horn should be about two inches less in length. Make all joints fit exactly, finish the inside smoothly, and use screws and glue in assembling the parts. The end for the phone should be about one and one-half inches square. The drawing shows the position of the horn in the cabinet. The bottom is purposely horizontal so that the sound will pass direct into the ears of the listener. A piece of fine screening stretched over the front of the horn adds neatness to the cabinet, and a frame over this with screws, as shown, support the horn.

Fitting the Phone

A loud speaker unit phone on which has been placed a soft rubber ear-cap, is wedged at the end of the horn as shown. Tighten the wedges as much as possible to make sure that the phone fits snugly. A phone of the mica diaphragm type serves very well in such a loud speaker. The phone cord is connected to a plug and passes through the front of the panel as shown.

Now comes the amplifier, which occupies the lower part of the cabinet. The panel is of bakelite or any other good insulating material. The layout is as shown in the

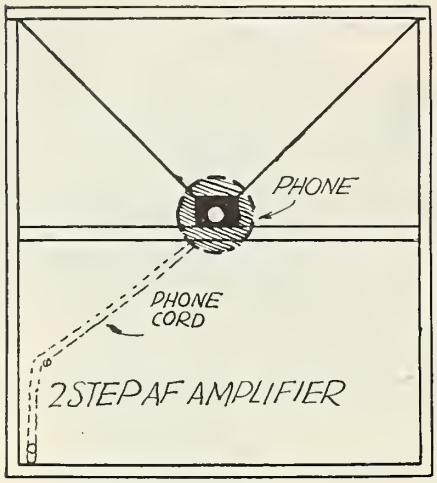

Figure 3. The front view with panel and screen removed showing how the speaker tapers down to the phone. The phone cord from the single phone unit is led down the inside back of the cabinet and across the bottom of the cabinet, out through a hole provided in the panel for it. The plug shown in Figure 1 can be inserted into either the first or second stage of amplification.

drawing on page 12. Binding posts are provided for A and B batteries and also for the input. There is one jack of the double circuit type, and one of the single circuit type. Of course, the transformers are of the audio frequency type and the tubes are of the amplifying type. Solder all connections and avoid parallel wiring whenever possible. A coat of stain completes the amplifier.

Connect the phone binding posts of your set to the input binding posts of the amplifier. Plug your phones into the first jack, and tune in to the desired station. When you have it reasonably clear light the filament of the second amplifying tube, and plug in the loud speaker to the second stage. Thus the entire family can enjoy the wondrous programs which broadcasters so kindly provide at great expense, and which all was made possible by the radio engineers and the scientists of the world who labored years to put radio where it is today.

First Radio Home

Radio is fast becoming indispensable as a household service, not unlike permanent features such as light, power and heat. Radio receiving sets are now considered by architects as fixtures, and the details of wiring, battery space and antenna installation are being written into specifications.

One of the first radio homes—that is, with facilities for radio built into the house—is that of L. E. Whittemore, Secretary of the Governmental Inter-Department Radio Advisory Committee. Before construction was begun, Mr. Whittemore explained his radio requirements to the architect, who included in the plans all radio facilities required by this engineer and enthusiast.

A nonmetallic conduit pierces the study wall for a lead-in wire; another goes below to a special space in the cellar reserved for the batteries, while a third is for the ground lead. Another piece of conduit pipe will carry leads from the set to a floor or wall socket in the living room, where a loud speaker may be installed if desired.

Besides fixtures for erecting an aerial on the house top, the owner plans to install two single, vertical loops in the north and west wall spaces of his study, the wires terminating in special sockets for an antenna plug connected with his set. This feature will give him certain directional selectivity, as he can use, at will, the loop facing east and west or one at ninety degrees to it.

How Many Sets?

The question: "How many radio receiving sets are there in the United States?" may soon be answered, if a scheme under consideration by officials of the Department of Commerce works out satisfactorily.

As an experiment, the radio section of the Bureau of Navigation permitted the two local Class B broadcasters in Washington (WCAP and WRC) to request all residents of the District of Columbia who have receiving sets to report to the Department of Commerce by dropping a postal card. This self-taken census will give an accurate return, it is believed, as well as save the government considerable time and money by eliminating the need for enumerators.

Those possessing receiving sets have a certain pride therein, it is said, which should hasten the reports. The radio section will classify and enumerate the cards, but that will be enough, it is pointed out, considering that no added personnel is available.

If the test radio census of the district proves accurate, the plan will be extended through all the states, in an effort to learn just how many sets there are in operation and what percentage are tube and crystal sets.

The latest authoritative estimate as to the number of receiving sets in this country on June 1, 1923, was 2,250,000, but it is not exact and is not official. Later predictions state that by June 1, 1924, a million more sets will be in use, making the total three and a half millions.

Results of the first day's mail following the broadcast of the census announcement brought the department forty-six postals.

The sole purpose of the census is to ascertain the number of receiving sets in the country and to gain an idea of the popularity, value and entent of broadcasting. There is no intention to levy a tax on receiving sets, as is done abroad, officials declare.

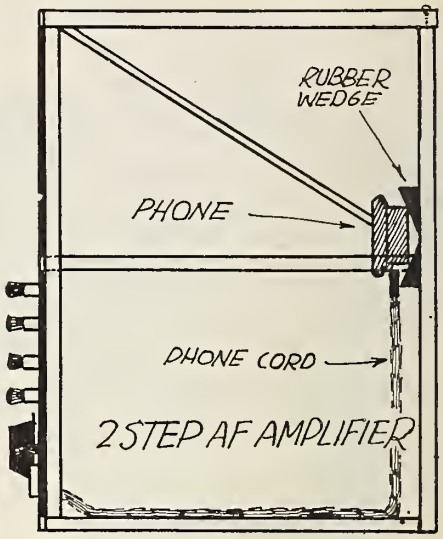

Figure 2. The sideview of the amplifier loud speaker reveals the method of wedging the phone of the mica diaphragm type to the tone arm of the loud speaker.

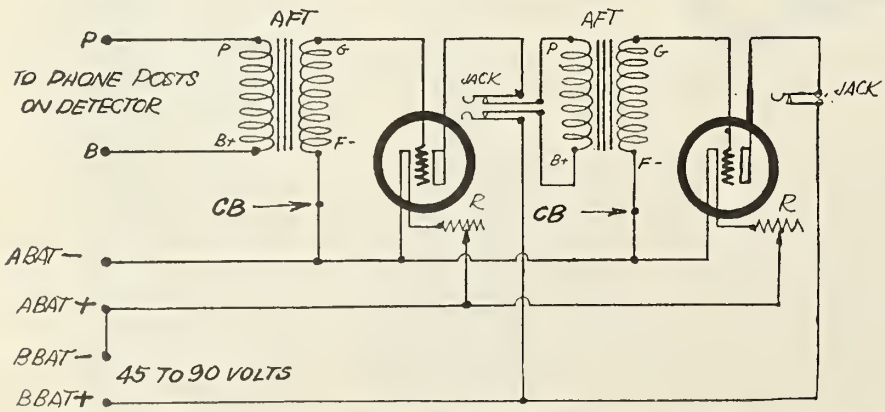

Figure 4. This shows the circuit diagram of the two stage amplifier used in the combination loud speaker amplifier. If WD 11 or other small, dry-cell type tubes are used, a C battery of one and one-half to three volts should be inserted at the point marked CB, with the negative side of the battery going to the transformers.

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Building the Haynes DX Receiver

By FRANK D. PEARNE

A GREAT deal of interest is being shown in the new Haynes DX receiver, and as many of our readers are looking for information regarding it, an explanation and description at this time is opportune. This circuit is the result of several years development on the part of A. J. Haynes, of New York City, who started out to make up a good arrangement combining all the well-known advantages of the different types of tuners in a simple way.

Adding to it gradually, eliminating unnecessary apparatus from time to time, he finally gives to the public a circuit which is extremely simple of operation even in the hands of a novice, but which still has all the desirable characteristics of the more complicated sets in use today.

As an example of what may be expected from such a receiver, Mr. Haynes says that when using a single wire aerial approximately thirty-five feet high and one hundred twenty-five feet long, located in a suburb of New York, stations in St. Louis, Chicago, Louisville, Fort Worth, Minneapolis and Havana, Cuba, were all heard in one evening. This certainly is a record for such a simple contrivance Nothing of any importance to good selective tuning has been omitted and still a casual glance at the drawing gives one the impression that there is nothing to it.

Carefully studying the circuit, one is reminded of the well-known Reinartz hookup, but in this case the plate circuit inductance is not adjusted by means of a switch lever cutting in more or less turns, but in this case the more accurate and closer tuning tickler coil is employed. Also the step-up ratio between the primary and secondary coils is considerably higher than that of the Reinartz. The primary and secondary combined, act as an auto transformer with the variable condenser bridged across the secondary, which makes a separate oscillating circuit of the part used as the secondary, which gives a very powerful impulse to the grid of the tube.

The entire inductance is made in the form of a bank-wound variocoupler, giving the appearance of the well-known single circuit tuner so far as the adjusting controls are concerned. One can almost trace the gradual development of this circuit by giving it a little thought and to those familiar with the standard circuits of today, it is an easy matter to see that only the best of each of them has been used in this arrangement. Figure 1 is the general panel layout showing the approximate location of the parts. No baseboard is necessary if a panel mounting type of socket is used.

The Variocoupler

The variocoupler used by Mr. Haynes is of the 180 degree type and is bank-wound. Just why this bank winding is used, he does not explain, but probably it is necessary to get the required number of turns on the primary winding. Bank-wound coils are, as a rule, only used for purely mechanical reasons, such as space considerations, etc. They produce large values of inductance with very small coils and are gen-

This shows the electrical connections of the instruments as illustrated isometrically in figure 1. The accompanying article describes in detail the winding of the coils.

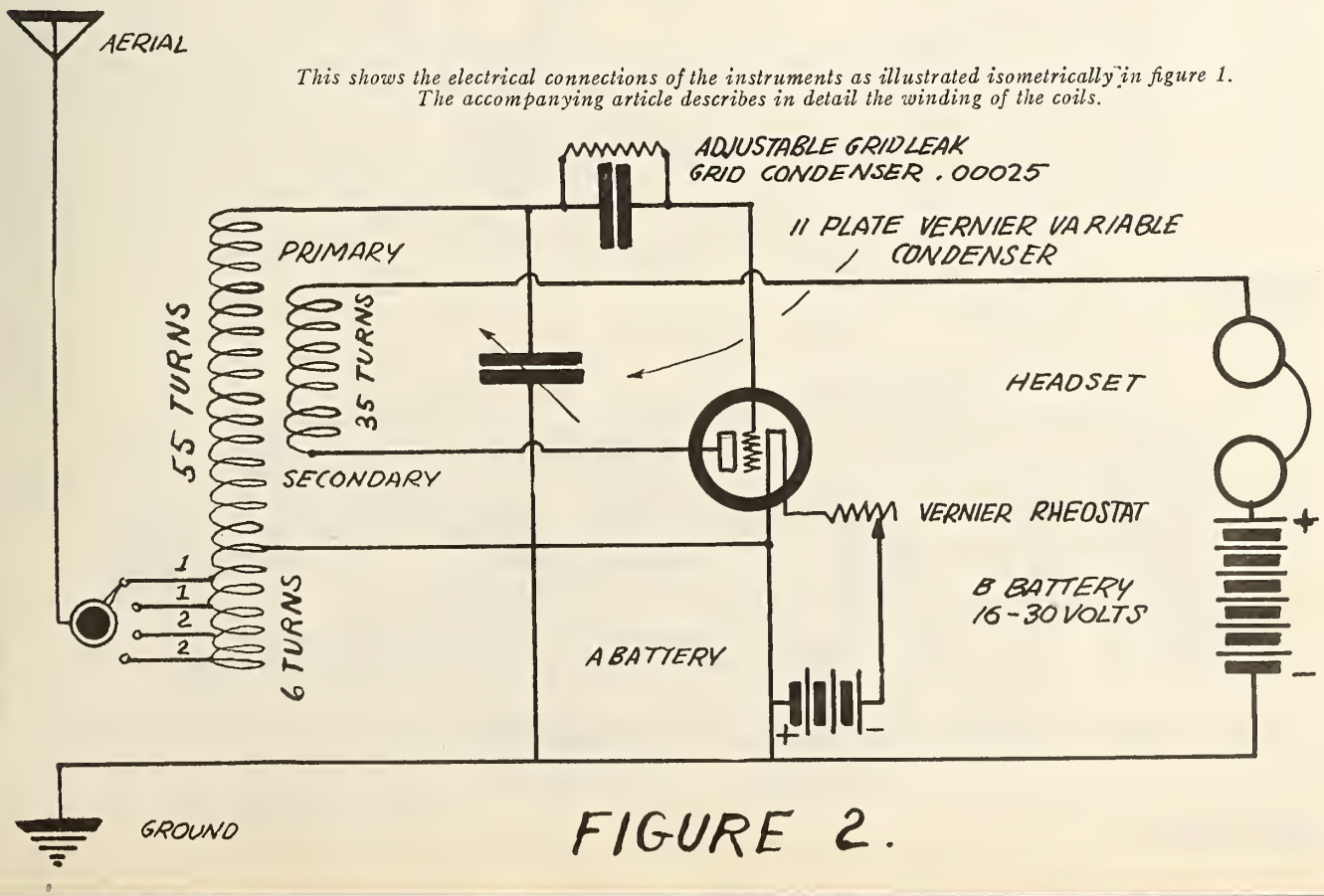


FIGURE 2.

erally used for long wave reception. The 180 degree couplers, without any winding on them, can be procured at most any radio supply store and the builder is advised to secure one of these and do his own winding.

As the signals are received at radio frequency and these high frequency currents travel on the outside of the wire, it is necessary to use wire as large as possible and still be able to get the required number of turns on the tube. It should not be smaller than No. 20. Figure 3 shows the method of winding the bank-wound coil.

Two holes are punched in the tube at "A" and "B" to serve as an anchor for the end of the coil. The end is put down through hole "B" and brought up through "A," leaving the end of the wire long enough to make the final connections after the winding is complete. The first and second turns are wound side by side and the third turn is wound on top of these, in such a way that it lays in the grove formed between 1 and 2. At the completion of the third turn, the wire is again brought down to the tube and the fourth turn is wound next to turn 2. The fifth turn is then wound on top and in the grove formed between turns 2 and 4, etc. After winding 55 turns, a tap is brought out to be connected to the ground when the set is wired. Put on the 56th turn and bring out another tap; also a tap is brought out from the 57th turn. After this, wind 4 more turns, bringing out a tap every 2 turns. Thus the primary coil is tapped at the 55th, 56th, 57th, 59th and 61st turns. However, the 61st turn will not be a tap, but will be the end of the coil. This completes the winding of the primary and secondary.

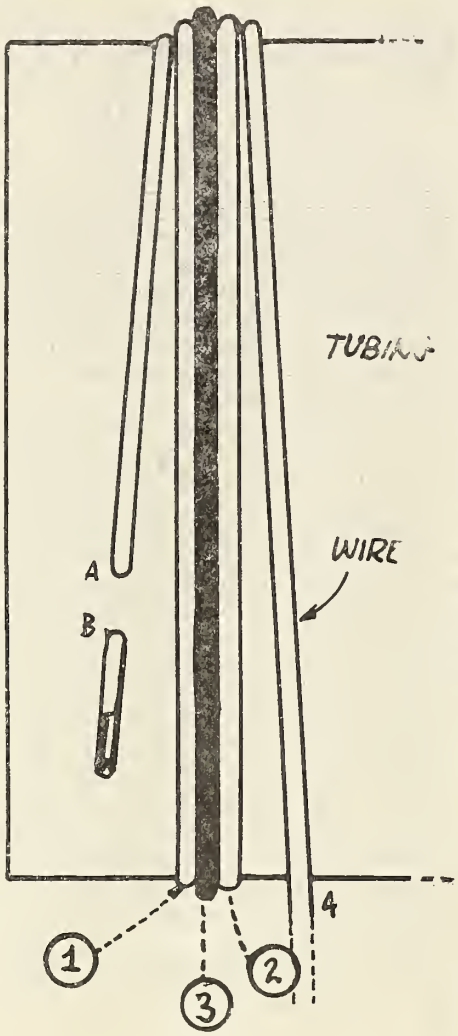


Figure 3. This illustrates the winding of the bank-wound variocoupler primary of the DX receiver. Two holes are punched at A and B and the first turn is put on as shown at 1. The second is wound immediately alongside of 1, and the third shown at 3 is wound on top of these two in the groove formed by the wires 1 and 2. The fourth turn is wound alongside the second, and fifth is wound in the groove made by 2 and 4.

The rotor is wound with 35 turns of wire. The exact size of this wire cannot be given, as the winding space on these different types of couplers will vary to some extent. If it is found that there is plenty of room, use No. 18 wire, but nothing smaller than No. 20 should be used. This part of the apparatus used is the only part which differs from the standard apparatus used in any ordinary receiving set.

The condenser should be an 11-plate variable, vernier condenser and should be the best that can be obtained. Remember, that this set is a combination of all the good parts of several different types and to get the maximum results, the best of apparatus should be used. The grid condenser should have a capacity of .00025 M. F. and must be of the mica insulated type. For the grid leak it is suggested that a variable be used, because of the different characteristics of the detector tubes which may be employed.

This is more important than one might think, as every time a tube is replaced, it will be found necessary to adjust the leak to that particular tube. Of course some results will be obtained with a fixed grid leak, but if one wants the best reception possible, this resistance should be variable. To get the greatest volume, the detector tube should be either a UV-200, or a C-300, but a WD-11 or WD-12 may be used in case one does not care to use a storage

(Continued on page 41)

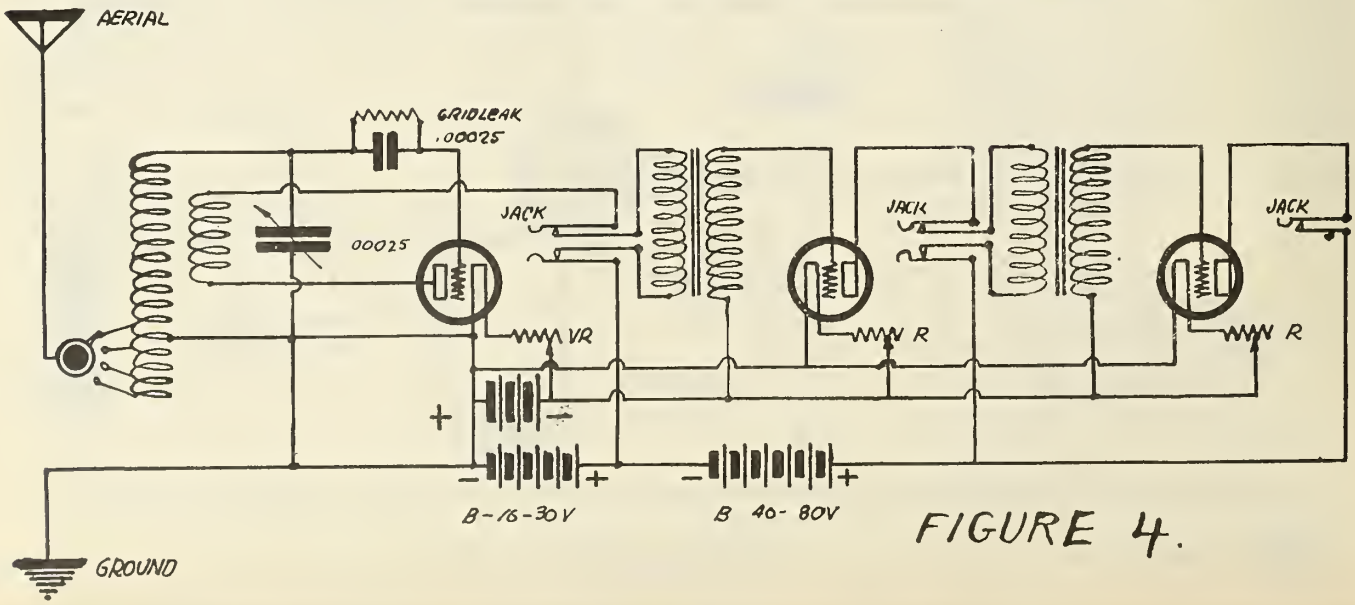


FIGURE 4.

HAYNES RECEIVER AT A GLANCE

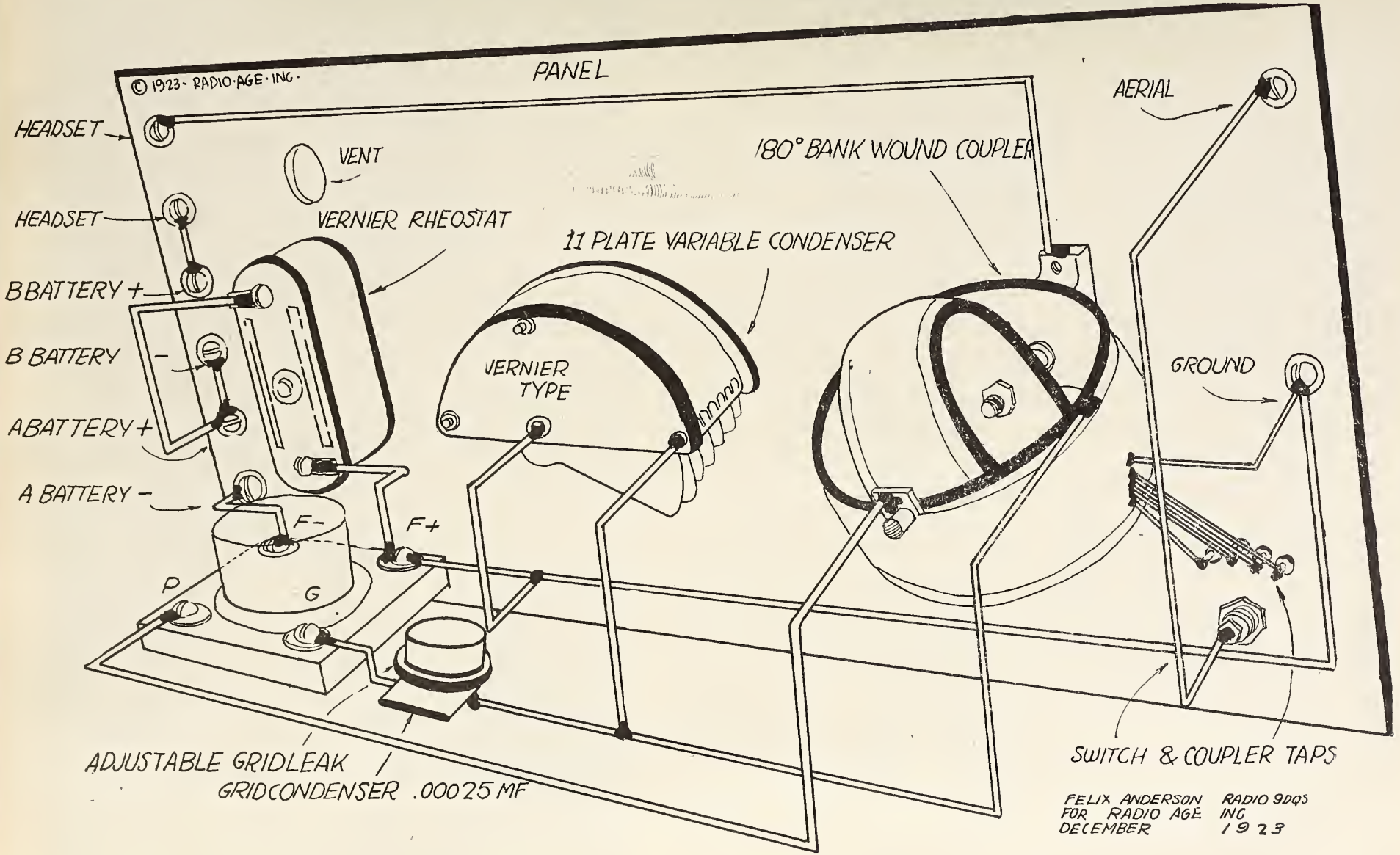


FIGURE-1

Principle of the Crystal Detector

THE crystal detectors are the simplest of all radio detectors used at the present time. Unlike the vacuum tube, it does not in most cases require a local battery for its operation and the initial cost is practically the last cost, says Beverly B. Dudley, Chicago member of the American Radio Relay League. The crystals are inexpensive, easily obtained, and can easily be replaced with little trouble, should the old ones become inoperative or dirty. Their disadvantages are threefold. They are critical to adjust; they are not as sensitive as vacuum tubes; and thirdly, they cannot be made to oscillate for the reception of amateur continuous wave signals.

The Contact Point

Essentially the crystal detector, sometimes known as a mineral detector, consists of a crystal upon which a contact of copper or steel wire is made. It is this contact that permits the reception of signals, inasmuch as this contact is a rectifier of the radio frequency currents. Crystal detectors consist, in the commercial form, of a base, a metal cup in which the crystal is mounted, a wire contact, known as the cat whisker, a holder for the wire, and binding posts for convenient connections. The crystals used most commonly at the present are: galena, radiocite, silicon, carborundum, and bornite, in the order named. The first two require a light copper or phosphor bronze contact, while the rest work better with a heavier steel, needle-point contact.

The radio frequency energy in the receiving set, before it reaches the detector, is a weak, alternating current, similar to the house lighting current, but where the house lighting current alternates its polarity 120 times per second, this radio frequency current alternates its polarity 1,000,000 times (or more) per second: i. e., where the house lighting current has a frequency of sixty cycles, the radio frequency currents have a frequency of 500,000 cycles per second.

Current Reverses

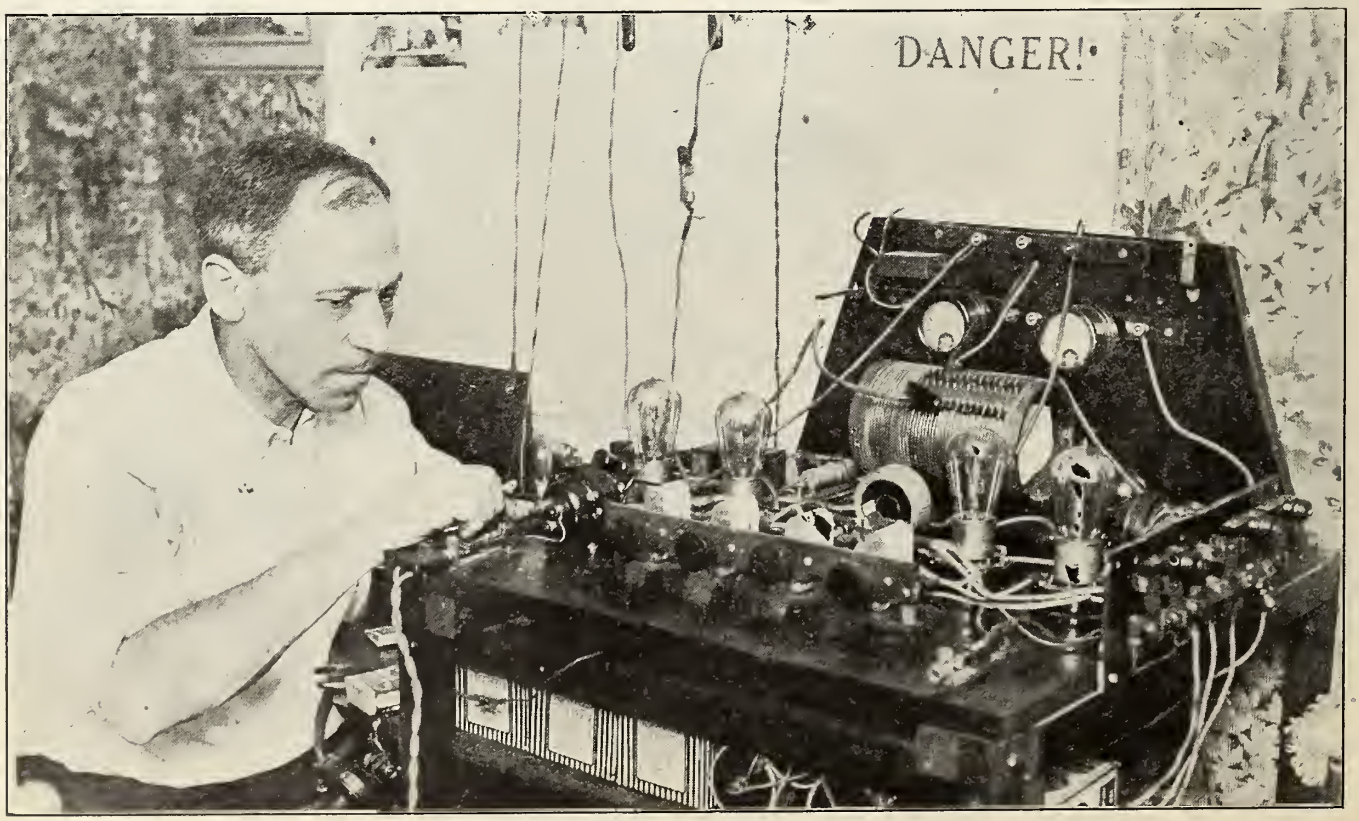
A current of this frequency cannot be heard for several reasons. When one of the groups of alternations acts on the telephone receiver, it causes no motion of the diaphragm, because each variation of the current in one direction is followed by the current flowing in the opposite direction, so that the telephone diaphragm has not enough time to start moving and resulting effect is no motion at all. Something that allows the current to flow through it in one direction and stops the current from flowing in the opposite direction is needed in the circuit, to actuate the diaphragm. The detector does this.

At the contact between the crystal and the cat whisker, current can flow through in one direction, but not in the other. Such oscillations pass through the detector, which suppresses half of these oscillations. This current is still vibrating much too fast for the telephone diaphragm to follow, but the successive impulses of current flow through the telephone receiver, and the impulses in any one group are all in the same direction so that their effects add and produce a motion of the diaphragm. The motion of this diaphragm causes sound waves which vary in pitch and intensity according to the rectified current passing through the windings of the receiver.

Hayes to Seattle

The Department of Commerce has designated Harold D. Hayes, of San Francisco, as assistant radio inspector to succeed Louis E. Richwien, of the Seattle office, who died recently. Mr. Richwein, who was transferred from Baltimore in 1922, served until recently at the headquarters of the Seventh District at Seattle, as assistant to Supervisor of Radio, O. R. Redfern.

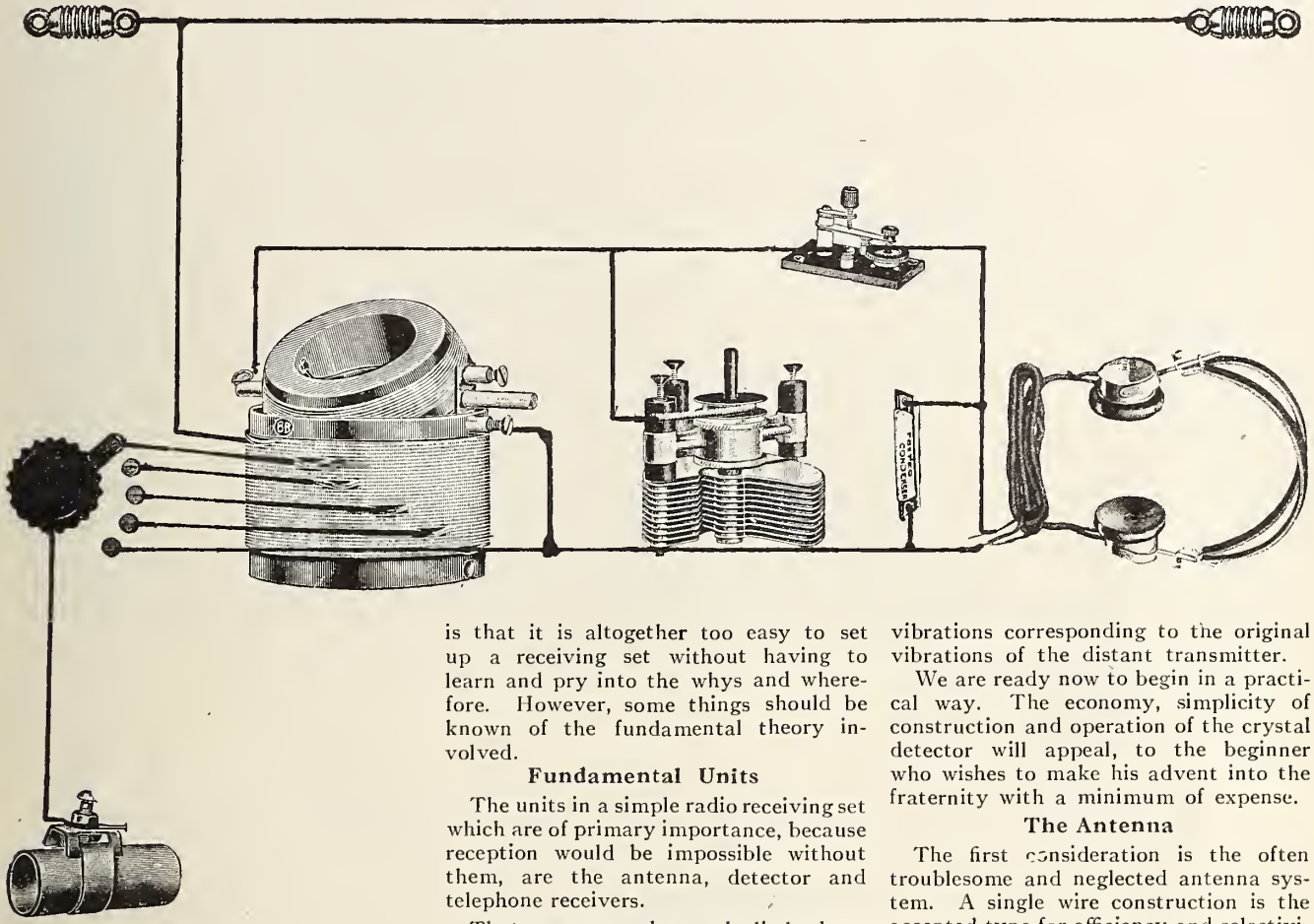
Temporarily, Mr. Hayes is serving as an assistant inspector at San Francisco, but he will shortly go to Seattle. Inspector Hayes is well-known in California, having founded the Y. M. C. A. Radio School in Los Angeles in 1912, one of the first radio schools to be established. 1917 he joined the Naval Reserve and served until after the Armistice as a lieutenant in the United States navy.



Leo Johnson, popular radio amateur, snapped as he was busy in his station, 2CTQ, Bronx, N. Y. Mr. Johnson's home is visited daily by many fans who want his expert advice. The transmitter covers long distances, largely due to its excellent construction. (Kadel & Herbert.)

A Selective Type of Receiver Employing a Crystal Detector

By J. A. Callanan



AS WE contemplate the increasing popularity of radio communication an outstanding fact is notable in the growing tendency of the experienced amateur to detach himself from the inexperienced. This is not as it should be. It is necessary for the common good that the new fellow should be offered not only the fraternal hand but a helping hand as well.

It is granted that radio has been developed almost entirely by the youth of the nation. Credit is due them for a great part of the speed of advancement the science has attained. Boys know more about such things than anybody else and we want to encourage all of them to go in for it.

It is our purpose to meet in a simple way the needs of those lads who look wistfully through the supply catalogues, but get no further, feeling that the cost of having a receiver is beyond their means or that their electrical and mechanical knowledge is insufficient to cope with the construction of apparatus so wonderously portrayed.

Radio reception is what the beginner of today usually starts with, because of its simplicity. The truth of the matter is that it is altogether too easy to set up a receiving set without having to learn and pry into the whys and wherefore. However, some things should be known of the fundamental theory involved.

Fundamental Units

The units in a simple radio receiving set which are of primary importance, because reception would be impossible without them, are the antenna, detector and telephone receivers.

That you may understand a little about the operation you must know that the human ear is able only to respond to a rate of ten thousand vibrations (waves) per second, and that as radio vibrations are many times more frequent the ear could not of itself hear the signals carried. There is, therefore, the necessity to break up their speed.

The antenna acts as a sort of collector against which the advancing vibrations crash, inducing in it a feeble voltage which maintains an electric current of high frequency. This circuit which is induced in the antenna overflows to the detector circuit where it is rectified.

Here we note that the function of the detector is to rectify these high frequency vibrations to permit of the electrical current flowing in one direction only. All forms of detectors operate on this principle. That is to say, they change the alternating nature of received vibrations to a pulsating, direct current. We see then, as a matter of fact, that the detector in spite of its name does not really detect the signals transmitted but merely alters the form of vibration. Rectified current is stored in a fixed condenser. As soon as this condenser has accumulated the charge of a single "wave train" it will discharge into the telephone receivers wherein it will cause vibrations corresponding to the original vibrations of the distant transmitter.

We are ready now to begin in a practical way. The economy, simplicity of construction and operation of the crystal detector will appeal, to the beginner who wishes to make his advent into the fraternity with a minimum of expense.

The Antenna

The first consideration is the often troublesome and neglected antenna system. A single wire construction is the accepted type for efficiency and selectivity. Its height is generally not important and its length should be from one hundred to one hundred and fifty feet, including lead-in. The fundamental wave length of this type is from 4 to 4.2 times its total length in meters. It should be well insulated from supports by means of porcelain cleats and kept away from other objects so that its small energy may be conserved and delivered to the receiver. Among these are trees, tin roofs, steel structures, iron pipes, etc. It should run at right angles to service lines carrying high tension currents.

All receiving circuits require a connection with the earth which is known as the ground. This connection from the set can be made with a radiator, cold water pipe or any such object which eventually makes good contact with the earth. This is an important feature and must have careful attention.

Municipal regulations and restrictions are enacted and must be complied with as must also the requirements of Fire Underwriters in the matter of antenna systems. In view of this the following outline is important for consideration of any one who plans the erection of an out of door antenna.

Rules for Aerials

Antenna shall not cross over or under

electric light or power wires of any circuit carrying a current of more than six hundred volts, nor shall it be so located that a failure of either antenna or service lines can result in a contact between them. It must be constructed in a strong and durable manner. Splices and joints, unless made with approved clamps or splicing devices, must be soldered.

Lead-in wires must be of approved metal, which will not corrode excessively; copper, copper-clad steel, etc., and in no case can they be smaller than No. 14 B S gauge. They must not come nearer than four inches to electric light and power wires unless separated from them by a continuous and firmly fixed non-conductor in addition to the insulation on the wire. They must enter building through a non-combustible, non-absorptive insulating bushing.

Lead-in wire must be provided with an approved protective device connected as near as practicable to the point of entry to building.

The ground wire may be bare or insulated and of like metal and gauge and must run in as straight a line as possible to a permanent ground as already cited. These details cover the spirit and intent of regulations governing erection of antenna systems and must be complied with to hold insurance valid.

The wiring diagram for the contemplated circuit is offered in a pictorial plan which is easily executed. First, we must be concerned with the units which are to be connected after construction.

Variocoupler

It would be much better if the builder of this Variocoupler would purchase a bakelite tube and wooden rotor for his work. However, this description is written for the novice and therefore only the most easily obtainable material is cited.

A card board tube can be used and is to be given two or three coats of shellac varnish for form and prevention of moisture absorption.

Drilling

Make the form four inches in diameter and three and one-half inches long. Drill two holes at one-fourth inch from each end of the tube with a number twenty-eight drill, repeating on the opposite side. These holes are indicated in both Figures 1 and 3 and are used for holding the bearings on the inside of the tube. With No. 24 double, cotton covered wire begin the winding at one eighth of an inch below these holes. Bring out a loop at every eighth turn until five loops and two ends are available. These are to be connected to switch points. When the winding is completed give it a good coat of shellac varnish.

The rotor can be made of a smaller card board tube which can revolve inside the larger. This must also be given several coats of shellac to prevent warping from moisture. A three-sixteenth inch hole is drilled through the center at opposite sides, as indicated in Figure 2. These holes are to allow the shaft to pass through the center as in C. Wind forty or fifty turns of the same number of wire taking care to leave sufficient space in the center between the winds of either end to permit the shaft to be run through the tube without contacting the winding.

The shaft is to project far enough outside of tube at one side to extend through a panel, allowing length enough for fastening of an insulating knob. It need only extend at the opposite side to reach through a bearing.

Two pieces of brass one-thirty-second of an inch thick are to be placed inside the tube and the shaft passes through them also. These are shown at arrow points C in Figure 2. After the shaft is located in the proper position through tube these two pieces of brass are forced up against the sides of tube and soldered fast to the shaft, see again C Figure 2. This fastens tube firmly to the shaft.

Next we make a pair of brass bearings shown at D, Figure 4. These are made of strips one-half inch wide and one-sixteenth inch thick, and bent in shape as indicated in drawing. Holes are to be drilled in the part that is bent over to allow for fastening them to a base after the coupler is assembled. These bearings should be held in position inside the tube and marked with a sharp, pointed instrument through the holes in the side of the tube. The bearing is then removed for drilling of holes at points marked. Use a number 33 drill for this, and tap them out with a 6:32 tap.

Bushings

The holes for the shaft as shown are to be drilled with a three-sixteenth inch drill and located just high enough above the edge of the tube so that shaft will not rub on the edge of tube. Two bushings of fibre or brass tube should be placed on shaft, between the rotor and bearings, to prevent the rotor moving back and forth after assembling parts. These must not be long enough to force the tube out of shape but just right to permit rotor to be turned easily by the shaft, without moving back and forth. The bearings are fastened to the side of the tube by means of 6-32 brass machine screws as in Figure 3. The part of the bearing which is bent over must be turned in toward the center of the tube, otherwise the coupler cannot be assembled.

Solder Your Leads

After the variocoupler is put together, two flexible leads are soldered to the ends

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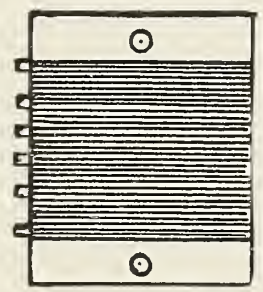


Fig I

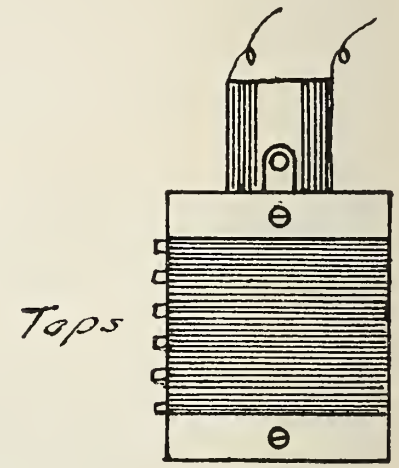
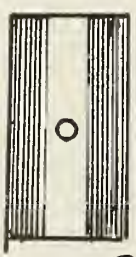
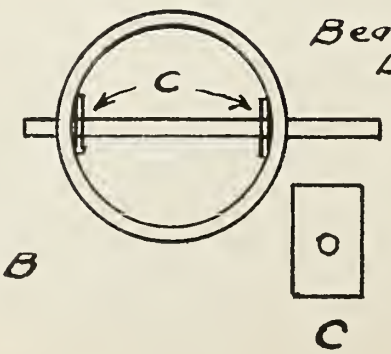


Fig III





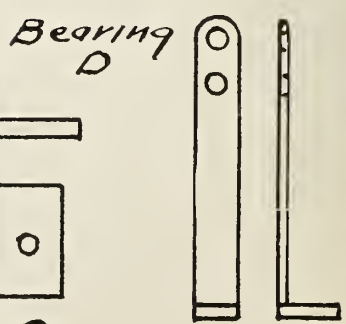
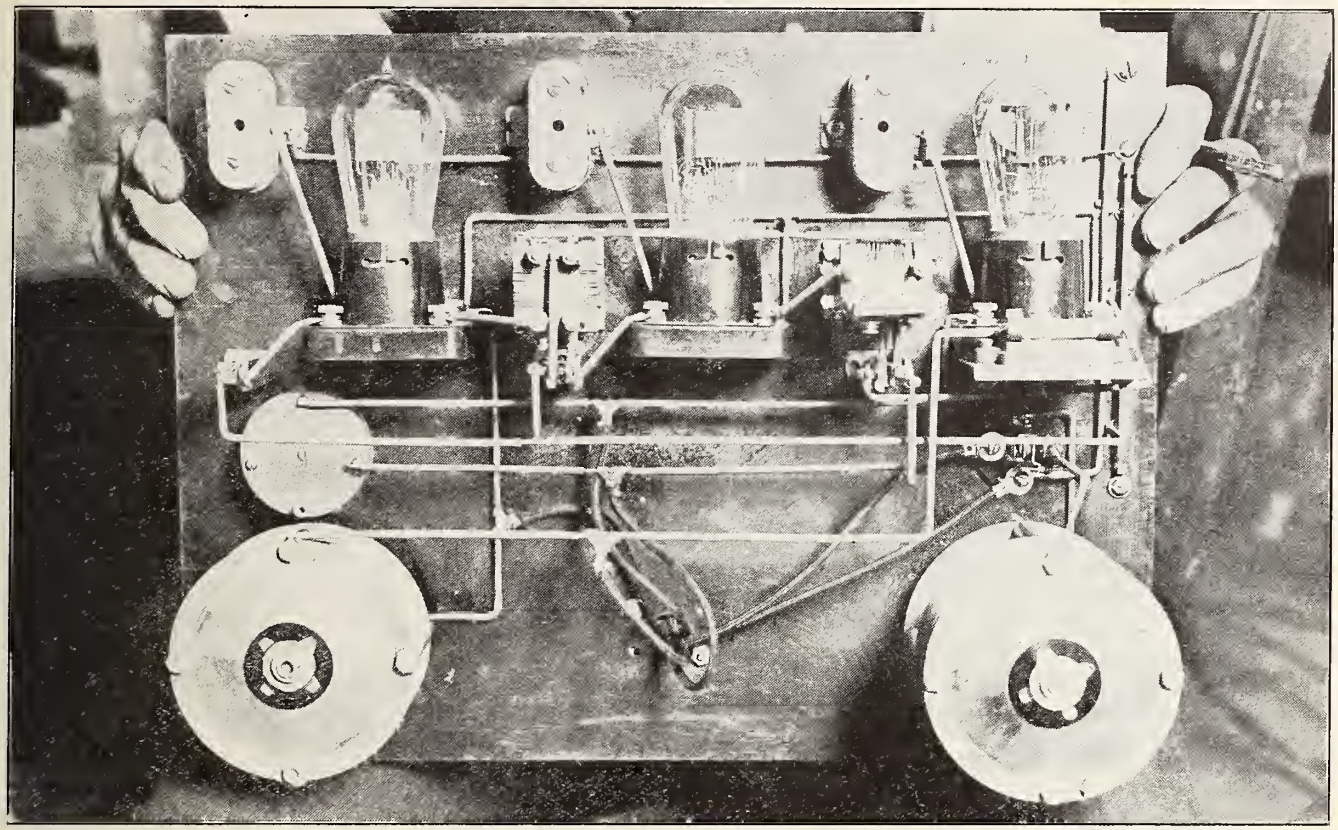


Fig II

Fig IV



For neat workmanship and arrangement, look at this three-circuit regenerative receiver, built by Sidney Kasindorf, New York. He has received some remarkable long-distance programs and messages with this outfit. (Kadel & Herbert.)

One Aerial for the Many Is General Squier's Vision

THE near future will see small compact and portable radio receivers, practically self-operating, in every home, according to Major General George O. Squier, Chief Signal Officer of the army, and one of the most advanced thinkers along lines of radio development. There will be no outside antenna, no complicated wiring, and no batteries in the ideal "fool-proof" set soon to be sought by up-to-date householders who will demand radio "service," just as they do telephone service today.

General Squier believes what he terms the second stage of radio development has arrived. When an invention first becomes popular, there is always a lot of energetic mechanics or electricians, both professional and amateur, who delight to tinker with the new apparatus. Some of these constructors have aided in the perfection of radio receiving sets, the general points out, but today the chief demand is for efficient sets which will be practically self-operating and will approach the ordinary telephone receiver in simplicity, taking their power and broadcasts from a single source or at least a central distributing point.

It would be impossible for every tenant in a thousand, or even a five hundred, apartment building or hotel to have an individual antenna. The roof of the hotel would be literally covered with aerials. The elimination of lead-in wires and batteries is also desirable, so that sets can be taken from room to room and plugged in. Naturally some local company, probably the power company, must furnish either the broadcasting by wired-wireless and at the same time the power for operating the tubes of subscribers, or erect its own main antenna on the outskirts of a city and distribute the broadcasts by wire locally. This scheme would involve combining General Squier's wired-wireless system of transmitting over light or power lines and regular radio transmission.

That broadcasting would not operate so successfully over a telephone system, was quickly shown by General Squier when he pointed out how the system of phone wires was constantly being broken down and rebuilt between different points whereas the light wires remain a stable net work running to each and every hotel, home, hall and store.

General Squier anticipates the development of local broadcast distributors who will collect radio entertainment and news for re-distribution or who will establish wired broadcasting for local subscribers. Coincident with the establishment of this system, will come the standard receiving set capable of being moved about the house and plugged in like a vacuum cleaner or electric fan, he believes.

Some listeners-in are already using the electric companies' lines to receive on instead of aerials, through a special condenser plug. Many possessing tube sets are utilizing inside loops. Practice is tending toward simplification and reliability in service the general insists. There will always be many real fans who want to build and rebuild their sets, but others are not mechanics and prefer ease in operation, reliability and compactness, to continual experiments.

"Hideous skylines covered with wire spider webs and rooms criss-crossed with wires will soon disappear," General Squier said, calling attention to some of the larger hotels and steamships which have already undertaken to serve their patrons with continuous radio broadcasts, from a central system. "The indispensability of broadcasting will make consolidation and simplification a necessity," the general concluded.

Radio 'Round-the-World

By Washington Radio News Service

WASHINGTON, D. C.—As a means of direct communication and for the entertainment of people of practically every race, radio is rapidly taking a place in world affairs unprecedented and unanticipated by forecasters, not excepting the visionary Jules Verne, who predicted several time and space eliminators.

Many new commercial radio circuits have been opened within the past two months, while further construction is announced nearly every week. Broadcasting, born in the United States as recently as September, 1921, has spread rapidly, and is coming to be a necessary feature of practically every country, stations being operated either by the governments or private companies. But America still leads in commercial radio enterprises, broadcasting, and in the manufacture of equipment which goes to forty or more countries.

Sweden

A combination to control broadcasting in Sweden has been formed, but until the Swedish law forbidding private individuals the use of radio receiving sets is modified by the Riksdag, general broadcasting cannot progress very far. The king has authority to permit the use of receiving sets, and to date 300 such permits have been issued, it is understood.

A change in the existing law granting private use of sets will be presented to the parliament early in 1924, the Minister of Communications announced recently.

Judging from the importance of some firms in the broadcasting combination, called the Svenska Rundradio Aktiebolag, it is believed it will be able to secure sole rights to broadcast in Sweden for ten years. The capital stock of the organization is said to be about 300,000 kronen; headquarters will be in Stockholm. It is the plan of the company to license receiving sets, the king to fix the rates, suggested as twenty crowns a year. An amount equal to five per cent of the fees will go to the government. The gradual building of governmental sending stations is planned, each station to be at the disposal of the broadcasting company for five hours a day, for which the company will pay the government. Wave lengths and interference are to be controlled by the government. On its part, the company binds itself to broadcast news, weather reports and various kinds of entertainment, also urgent and important news, free of charge to the government.

This company also plans to sell apparatus and parts. Discussion as to the kinds of apparatus to be licensed for reception is under way, the marine authorities insisting that the construction of the public sets should be such that listening-in on naval communication is impossible.

Norway

Work on a new government radio-telephone station at Vardo, on the North coast of Norway, to cost approximately 95,000 kronen, is reported as underway, by Consul Ifft, at Bergen. It is expected that this station will soon be in communication with the telephone broadcasting stations at Ingo, Tromso and Spitzbergen. The main object is to maintain communication with the fishing fleets.

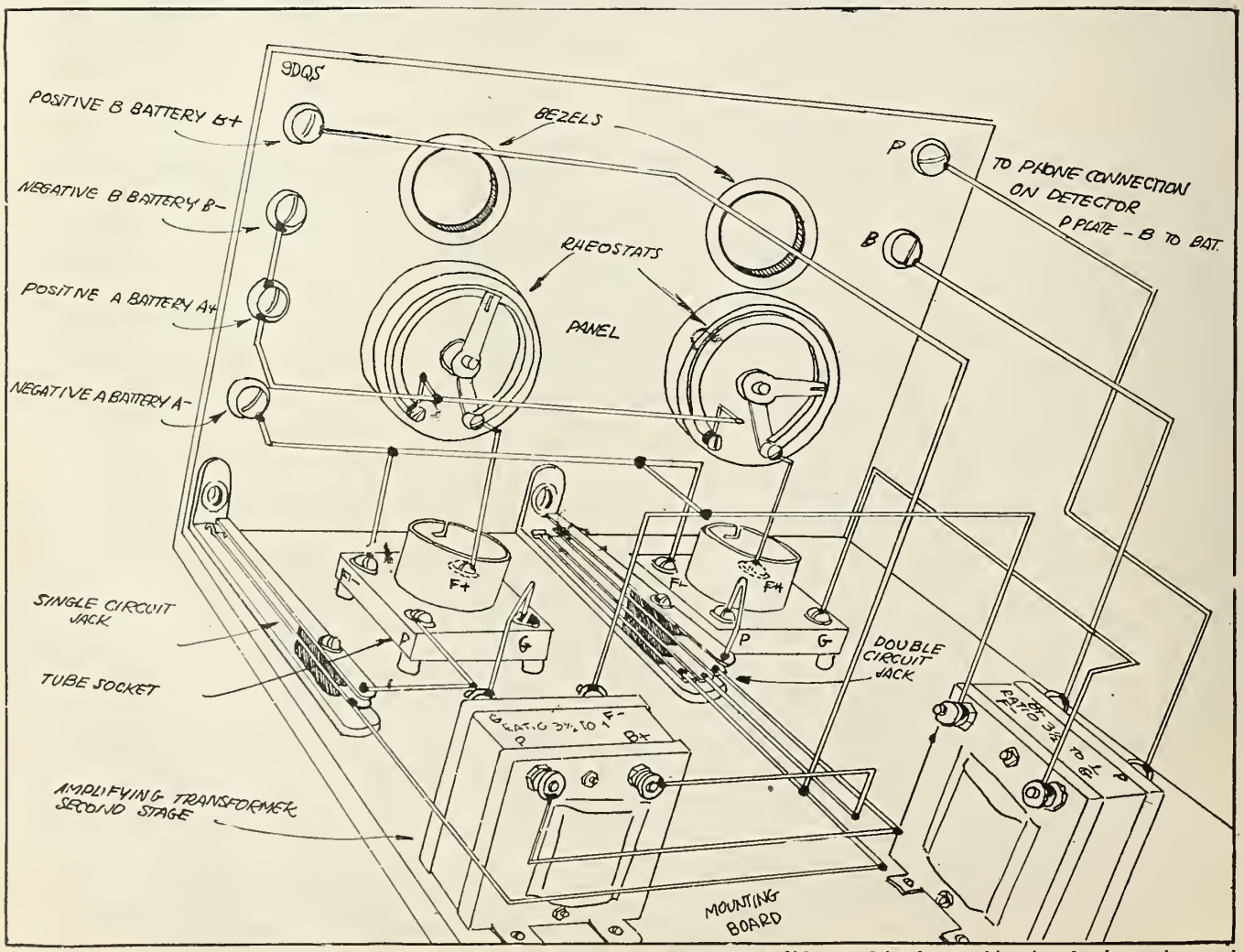


Figure 5. This illustrates the panel arrangement and wiring of the two-stage amplifier used in the combination loud speaker and amplifier described on page 13. Full instructions concerning the construction of this unit appeared in the August issue of RADIO AGE.

What the Broadcasters are Doing

(News for this department is solicited from all stations)

University Extension

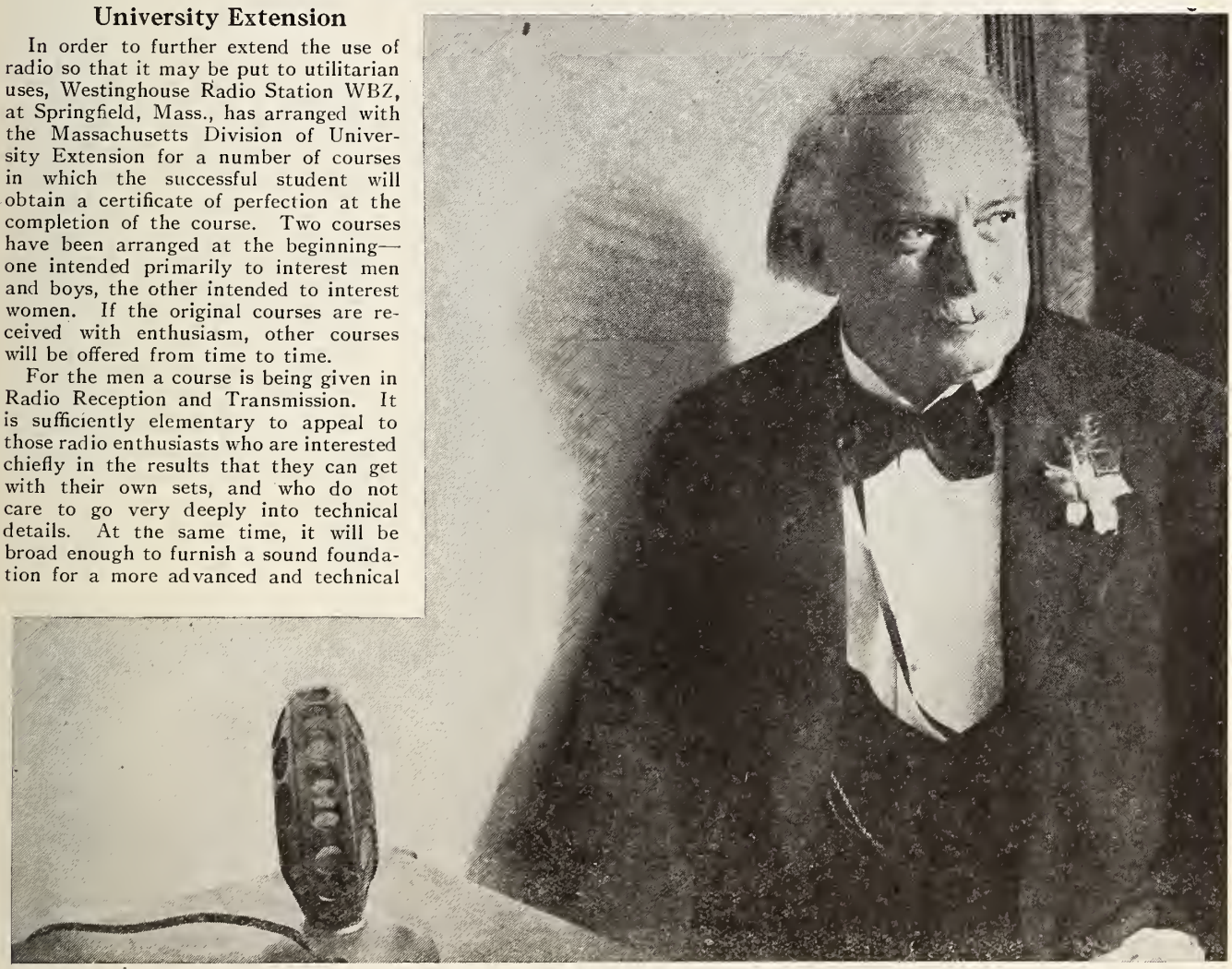
In order to further extend the use of radio so that it may be put to utilitarian uses, Westinghouse Radio Station WBZ, at Springfield, Mass., has arranged with the Massachusetts Division of University Extension for a number of courses in which the successful student will obtain a certificate of perfection at the completion of the course. Two courses have been arranged at the beginning—one intended primarily to interest men and boys, the other intended to interest women. If the original courses are received with enthusiasm, other courses will be offered from time to time.

For the men a course is being given in Radio Reception and Transmission. It is sufficiently elementary to appeal to those radio enthusiasts who are interested chiefly in the results that they can get with their own sets, and who do not care to go very deeply into technical details. At the same time, it will be broad enough to furnish a sound foundation for a more advanced and technical study of the subject. If a sufficient number of people show interest in this first course, a second and more advanced one may be given later in the year.

The course consists of ten lectures, one to be broadcast from WBZ, by Edward H. Goodrich, of Springfield, each Wednesday evening, from 7 to 7:20 p. m. The first lecture was given on Wednesday evening, October 3.

For women, the division is broadcasting a course in Household Management, consisting of eight lessons and given each Tuesday evening from 7:40 to 8

All radio users within range of this station are, of course, welcome to become part of the audience at these lectures. If, however, one wishes to take an active part in the course, he may enroll as a university extension student by sending to the Radio Station, Westinghouse Company, Springfield, Mass., his name, address, age and occupation, with the registration fee of $1. This application and payment constitute an enrollment and entitle the student to receive any study material that may be sent out by mail, and to submit lesson papers to a



When Lloyd George was in the United States he had an opportunity to discover how great a medium for reaching the masses the broadcasting station has become. Speeches made in New York, Chicago and other cities were broadcast to hundreds of thousands at a time. The above photograph was taken at the Metropolitan Opera House, N. Y. The former British premier's speech was broadcast from that auditorium by station WEAF. (Kadel & Herbert.)

WCAP Has Jazz Tube

The national craze for jazz may effect vacuum tubes: This is the latest development in radio broadcasting news. When a radio transmitting tube shows unmistakeable signs of becoming converted to jazz music and develops a blue light which dances in perfect cadence and absolute abandon to the "blue" notes of a moaning saxophone, what chance has the advocate of grand opera broadcasting radio engineers and operators ask?

Such is the situation at the Chesapeake and Potomac Telephone Broadcasting

time it broadcasts the music of Le Paradis Orchestra, or the Metropolitan Theatre. On all other occasions the tube maintains a solemn dignity befitting the occasion, and performs in a highly efficient manner, it is said.

The engineers who carefully avoid discussing the ethics of the equipment, rise to the defense of the tube to say that the blue light is probably caused by a small amount of gas which is present in some quantity in all vacuum tubes. When the tube is working, the gas becomes ionized, and if present in sufficient quantity, gives off a bluish light. The vividness of this light, it is explained, is increased with the modulation and with the changes in volume of the music. When a heavy chord is struck, the light visibly brightens, with the result that during a jazz piece the blue light keeps absolute time with the music, bringing out the beats, thus emphasizing the syncopation.

"That's as it should be," say the lovers of jazz, "even a radio tube gets a thrill out of popular music." The students of Wagner, Beethoven and Liszt, however, scoff at the idea, claiming "that jazz gives the tube the blues."

Birds in "Bird City"

Radio rooms on vessels must be used solely for the transaction of matters affecting communication and not as aviaries, if the suspension of the radio operator on the vessel "Bird City" is taken as an example.

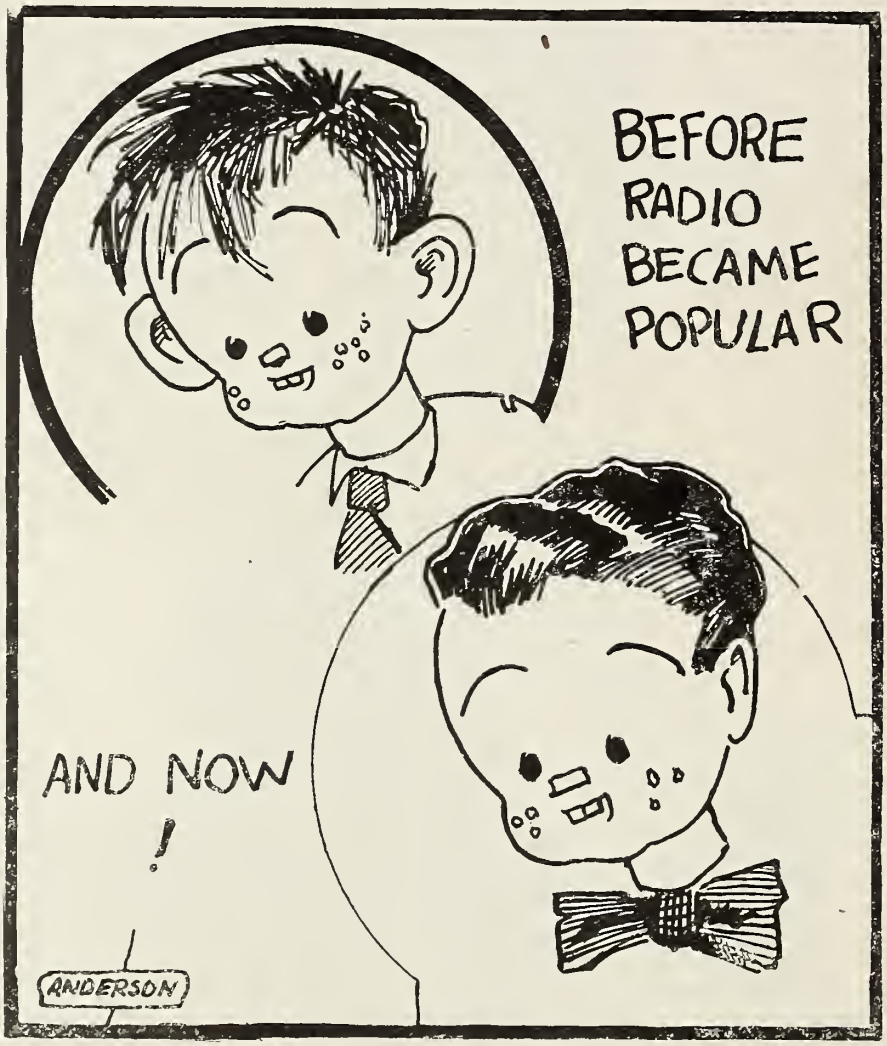
When a radio inspector visited this ship recently, he found that the radio operator had practically given over his shack and stateroom to a number of birds as a habitat which, despite the name of the vessel, is against the rules.

The inspector's report stated that when he entered the shack, he found a parrot roost suspended from the deck above. After a search, he found the parrot perched on a bus bar in the rear of the switchboard. Polly seed was all over the floor and chairs. In the sleeping quarters were found four canaries.

The shack, it is understood, was thoroughly cleaned and the bird tenants ejected from their quarters. When the "Bird City" again goes to sea she will have an operator who is not a bird fancier.

Visitor at WSB

Atlanta, Ga.—An eloquent instance of radio's influence in obliterating sectional lines and creating a national community spirit throughout America is cited in a visit paid to station WSB not long ago by a Pennsylvania fan. Harvey S. Rahiser, a Pittsburgh, Pa., architect, who made the trip solely to further a friendship fostered via the ether for more than a year. The Quaker state fan was met by a delegation at the train, was officially welcomed by the mayor of Atlanta, listened at first hand to a concert in his honor, was dined profusely on fried chicken and left Georgia three days later singing the praises of the home of "The Voice of the South."



Radio is a boon to mothers of boys who formerly refused to comb their hair and possessed ears which stuck out far enough to flap and scare flies off their backs.

Junior, after wearing the headphones for a month or two, acquires one of those radio marcels from continued wearing of the headband and the tension of the phones brings his ears back into their proper place.

Radio Twins

Atlanta, Ga.—Already claimant for the title of "godfather" of the world's first radio-christened baby, WSB boosted the station's average still higher recently when the proud parents of twins left the important matter of double nomenclature up to The Atlanta Journal radio staff. After receiving and acknowledging a flood of suggestions that followed an appeal for help during a concert, "The Voice of the South" announced that the pair of Georgia baby girls would be named Radiora and Radianna. The radio twins bless the household of Mr. and Mrs. W. E. Neary, of Smyrna, Ga.

Atlanta Symphony

Atlanta, Ga.—The Atlanta Symphony orchestra, a newly founded civic institution, will soon be added to the attractions broadcast by Station WSB. Although identified as a musical center through the nation's only annual season of Metropolitan grand opera outside of New York city, Atlanta until now has never supported a real symphony orchestra. The organization will include the finest professional musicians in the south, is backed by a fund subscribed on a municipal scale and is expected to take rank with outstanding symphony orchestras of the country.

Entertaining Artists

The reception room at broadcasting station, WOC, at Davenport, Iowa, has been equipped with a loud-speaking horn, so that the waiting artists and friends of those on the program may enjoy the selections being broadcast from the studio adjoining.

The circuit is so arranged that the horn operates only when the door to the studio is closed, thus preventing any possible 'feed-back' on the micro- phone.

Cleveland to Guatemala

Puerto Barrios, Guatemala, which is in Central America, is rather distant from Cleveland, Ohio, yet it is interesting to compute that a recent concert from a Cleveland broadcasting station was heard there in a small fraction of a second after the notes were impressed on the broadcasting microphone in Cleveland.

The letter telling of this long distance reception was received by the Cleveland station WTAM, from W. E. Godman, resident of Puerto Barrios, Guatemala, C. A. The incident is even more amazing

E. F. Mac Donald, Jr., Zenith-Edgewater Beach Station WJAZ, reading the latest news into the microphone for the entertainment of Explorer Donald B. MacMillan, who is ice-locked near the North Pole in his little ship "Bowdoin." It was Mr. Mac Donald who equipped the "Bowdoin" with sending and receiving apparatus, with results that have interested the entire radio world.

because of the fact that the WTAM concert was received by Mr. Godman with such volume on a loud speaker, that a curious crowd gathered outside his home to listen to the music coming from a point more than 1,500 miles distant in a straight line.

The Bishop's Watch

Radio fans who tuned in Sunday night to listen to a lecture by Bishop F. McDowell at Orchestra Hall, Chicago, began deluging the Sunday Evening Club with complaints that they couldn't hear the lecture for the ticking of the bishop's watch.

During the meeting of the Sunday Evening Club, which was broadcasted from Orchestra Hall through Westinghouse station KYW, Chicago, Bishop William F. McDowell, given only a certain number of minutes to speak, had taken his watch and placed it where he could conveniently watch the time as it passed—unfortunately, the microphone seemed to be about the only place of advantage where he could put it, with the result that the ticking of the watch went out as loud as his voice. More than a million people all over the country were listening. Here are excerpts from a few of the many letters sent to Westinghouse Station KYW:

Redington, Nebr., October 23, 1923.
Station KYW,
Chicago, Ill.
Gentlemen:

We had the pleasure of listening in on your station Sunday evening, October 21, 1923, and wish to say your signals came in wonderfully strong. How strong you can judge for yourself, when you stop to consider we live 450 miles West of Omaha, and we could hear the watch ticking as distinctly as we could hear it had we held a watch to our ear.

With best wishes, I am,
Very truly,
FRED GILMAN.

Palmyra, Nebr., October 21, 1923.
Station KYW,
Chicago, Ill.
Dear Sir:

Your last announcement explaining the watch tick that I heard out here in Nebraska certainly took a load off my mind for I would have lain awake trying to figure out where the tick came from. Your station is O. K.
CHARLES H. HULL.

Protect Ships by Radio

The Canadian government is about to install a powerful direction-finding wireless station at Pachena, on the west coast of Vancouver Island, British Columbia, to protect ships of all nations entering the Straits of Juan de Fuca en route to American and Canadian ports. Numerous shipwrecks have occurred in this district, and it is expected that the new radio beacon will enable vessels to determine their exact positions in foggy weather, avoiding many dangerous reefs thereabouts.

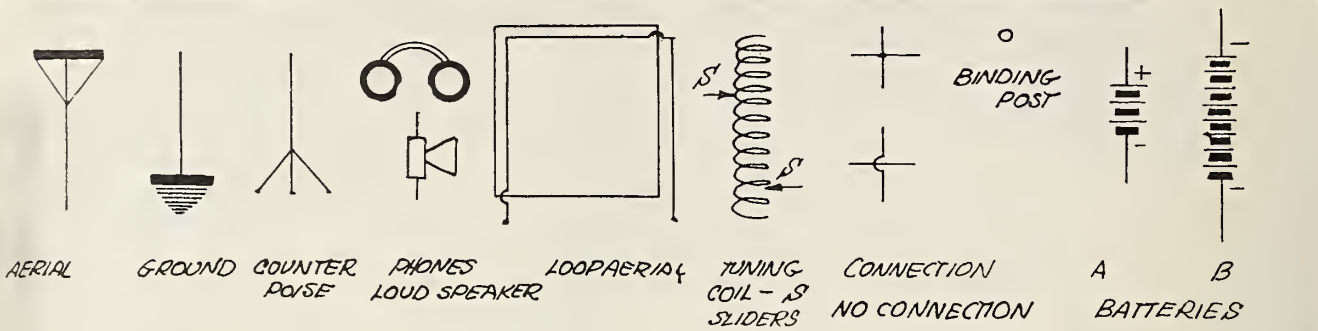
Bits from WGY

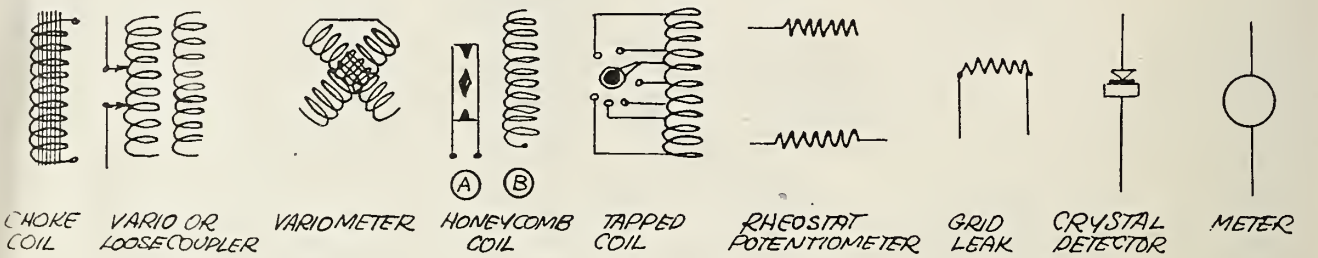
"Father is Scotch and takes the headphones off when the minister announces the offering," wrote eight year old Harold Midgley of Galt, Ontario, Canada, to WGY, the Schenectady, N. Y. broadcasting station of the General Electric Company.

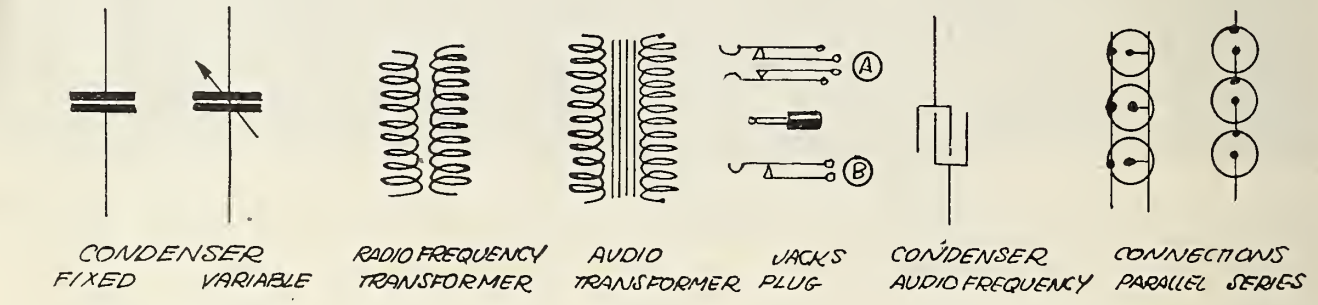
The radio storm created by WGY, in the production of "Peg o' My Heart," as a radio drama, was so realistic, according to Martin L. Wyman, Jr., of Gaysville, Vt., that his father took off his headphones, saying that he didn't care to listen in during a thunderstorm.

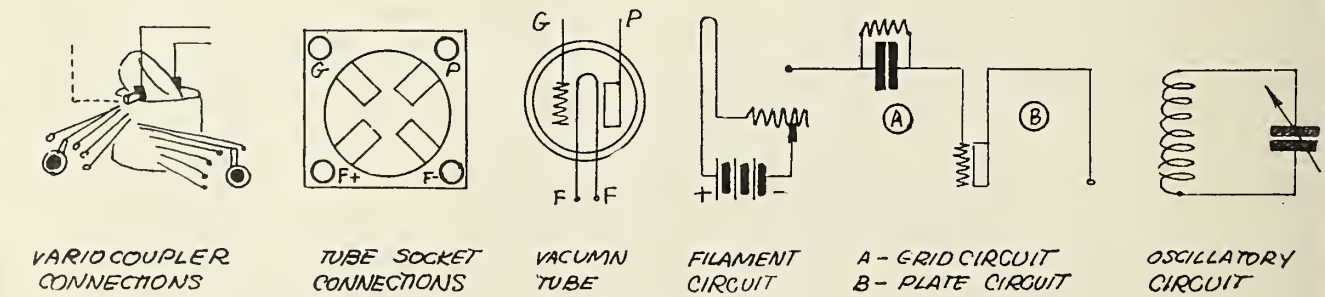
WGY indirectly controls the turning on and off of the street lights at Howard Beach, about twenty-five miles from New York. William L. Welling of that place reports that he depends on WGY for the correct time for the proper setting of the time clock which controls the operation of street lights in Howard Beach.

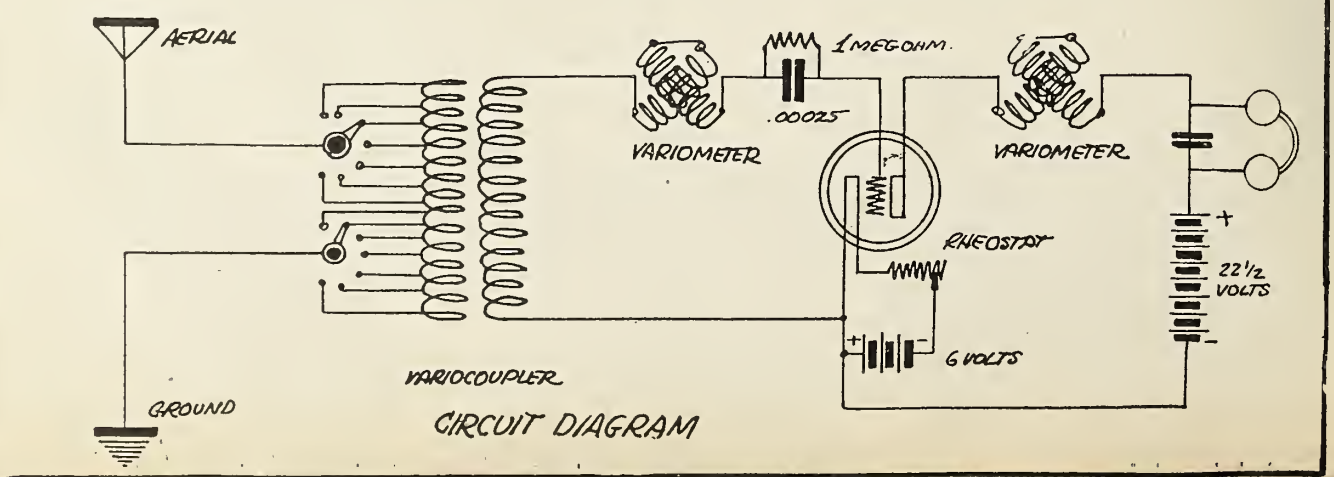
SYMBOLS USED IN RADIO AGE DIAGRAMS



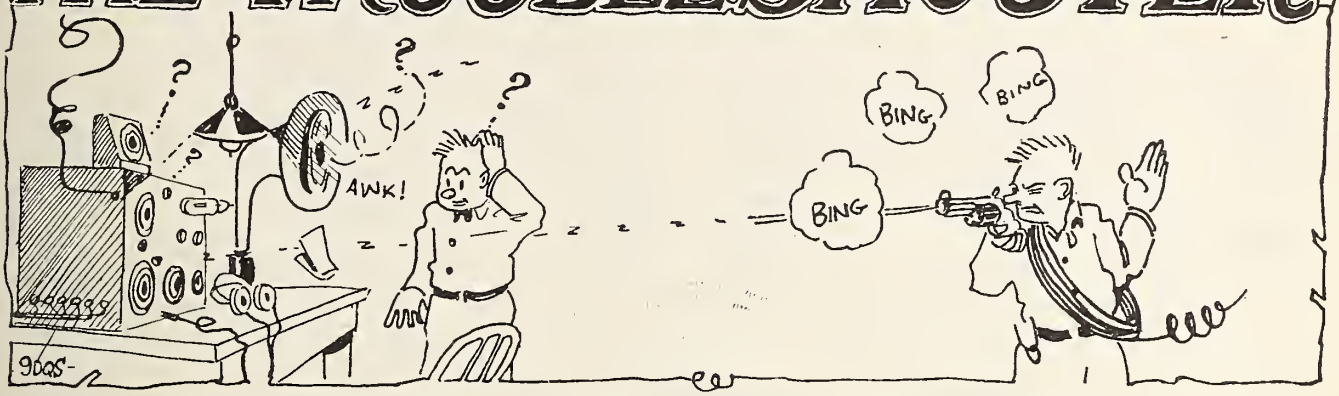








THE TROUBLESHOOTER



The technical department sends out many replies to questions in each day's mail. In order to assure prompt service to our subscribers the direct reply method hereafter must be restricted to those fans who are on our subscription list.

Fans who are not subscribers may obtain this service by enclosing 50 cents with their question and the reply will be mailed at once, accompanied by circuit diagram where illustration is needed.

All inquiries should be accompanied by self-addressed and stamped envelope.

G. S. P., Moline, Ill.

Question: I am enclosing a sketched diagram of a long-distance crystal set taken from a publication of yours. I desire to use a WD 11 tube in this hookup, and I have sketched roughly on the diagram enclosed, the way I have figured out the connections for the tube. I have put a variable condenser, of .0005 Mfds. capacity in the aerial lead instead of a fixed condenser. I am not sure about the phone condenser insofar as the tube connections are concerned. Kindly check over the circuit, making any corrections you see fit.

Answer: The directions for converting the long distance crystal set into a tube set were printed in the October issue of RADIO AGE, but I am printing for your and other reader's convenience another diagram, showing somewhat different connections for the parts in this set.

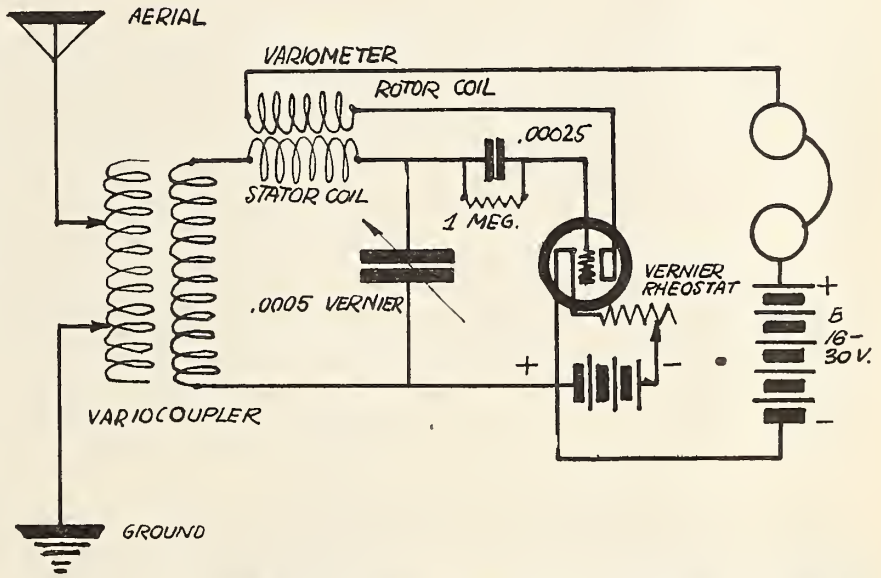


Figure 1. This is another arrangement possible, using the instruments of the long-distance crystal set in a one-tube hookup. The variometer is split and used in the circuit as shown. The set is highly regenerative and gives unusually loud signals.

E. A. B., Dwight, Ill.

Question: I am a subscriber to your magazine, from which I receive much benefit and enjoy every page. I am coming to your free service department for some advice. I have a honeycomb set with six-volt tube and one stage of audio frequency amplification, which gave excellent results for about two months, and then went wrong. I have tested A and B batteries and find them to be in good condition. I have tried different grid condensers, different type of tube and other coils, but with no appreciable change. The signals used to come in loud enough at times to be heard over the loud speaker but all at once they faded so that I can just barely hear them. Previous to this, when I touched the grid wire the set would howl, but now it just barely squawks; other times it seems absolutely dead. The set seems to oscillate O. K. but just has no pep. I have hooked-up just the detector alone in order to cut out the transformer but it is just the same. If you can give me any information, I would appreciate it very much.

Answer: You seem to have gone over the set pretty thoroughly, and I can offer only a few additional suggestions to follow out in order to locate the limitations of the set. First of all, would advise that you give your antenna system a thorough going over from one end of the antenna down to the very set. If you are using the rubber covered lead-in type of wire, would advise that you test it for breaks, especially in the lead-in, where I presume you are using insulated wire. Try a different ground connection. Make sure that the positive side of the B batteries are connected to the plates of the tubes. Reverse the tickler coil of the set. Test your headset by placing the two tips across a dry cell or flashlight battery. The headset should give a loud and firm click when the tips make contact. You might bend up the prongs on the tube socket to make sure they make positive contact. The July issue of RADIO AGE shows how to test condensers for short circuits, and I would advise your referring to this number and carrying out the test. Reverse the A battery connections, and test the B batteries with a volt-meter if you have one handy. If the 22 1-2 volt type test lower than 16 volts or if the 45 volt batteries test lower than 36, they are just about useless as far as radio reception is concerned. If after you have carried out these suggestions, the set fails to work, would then advise that you disconnect the entire set and rewire it, thereafter trying it on a different antenna.

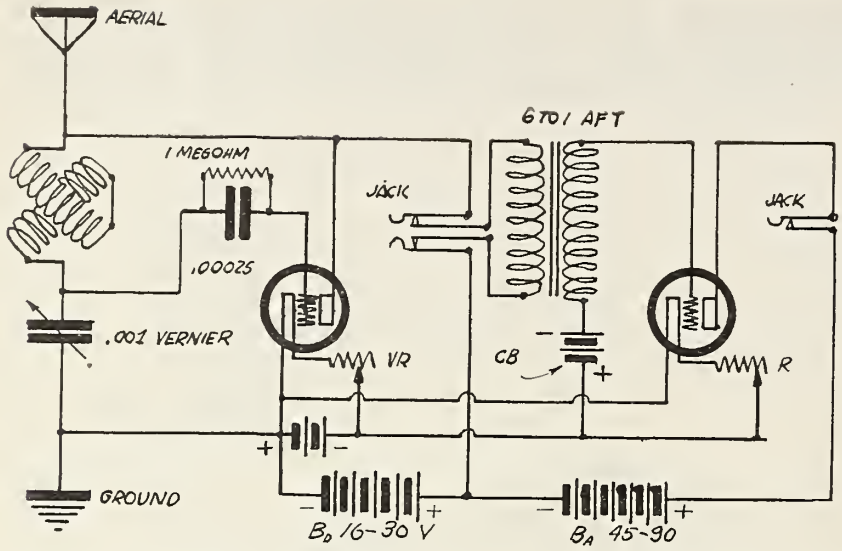


Figure 2. This shows the "First Tube Outfit" connections with the addition of a one-stage audio frequency amplifier. CB is a small flashlight battery, or dry cell, of one and one-half volts used as a grid bias, to assure the highest amplification factor when WD 11 tubes are used. L is the variometer. Full details concerning this set were given in the October issue of RADIO AGE.

G. L. T., Memphis, Tenn.

Question: With regards to the construction of the four-circuit tuner, as published in your August issue, the article says to use No. 18 scc wire. I cannot secure this kind of wire here but can get No. 20 or 22, enameled and cotton covered. Would this make much difference in results? It also says to use a 3 1-2 or 3 1-4x6 tube. Is it possible to bank wind coils A and B to save space?

Answer: It will be necessary for you to use the wire as specified in the data, inasmuch as the constants of the circuit have been carefully worked out, and any changes would bring about doubtful results. The difference in inductive effects and distributed capacity will not permit the winding of the A and B coils in bank wound form, as you suggest. I would suggest that if you are having trouble in constructing the coils that you buy them already wound. The coils advertised elsewhere in this magazine will serve the purpose admirably.

H. H., New York City, N. Y.

Question: In your October issue, you show a diagram of a simple receiver. I am partial to this set, and would like to construct it and would like to have a copy of the circuit with the addition of one stage of audio frequency amplification. I am going to use WD 11 tubes.

Answer: This little set has proved itself a popular receiver among beginners, due to the simplicity of construction and the long range it affords. Inasmuch as we have had so many requests for circuits showing the addition of audio frequency, I am printing in Figure 2 a circuit showing the addition of one stage of low frequency amplication, and in Figure 3 the set with two stages of amplification.

M. A. B., Pasadena, Calif.

Question: I have a two-tube Erla reflex circuit and one stage of audio frequency, which is made up of Erla parts with the exception of the audio transformer. I get a large howl that is very troublesome. I disconnected the .00025 fixed condenser across the 11 and 23-plate condensers and the howl stopped but now I cannot get any long-distance nor can I hear from the loud speaker. I like your magazine very much and take pleasure in recommending it to others.

Answer: Put the .00025 Mfd. condenser back where you took it, ground the transformer core, and place a .001 Mfd. fixed condenser across the primary connections of the audio transformer. If there are any wires in the amiplifier that run parallel for any distance, change them, and if necessary, move the audio transformer clear of the rest of the parts of the set.

C. H., Milwaukee, Wis.

Question: I wish to build the Reinartz circuit, and would like to know what ratio of audio transformer to use on the first and second stages of the amplifier, and what resistance potentiometer to use on the set.

Answer: For the first stage of audio amplification use either a 6 1-2, 6 or 4 to-one ratio. If you want a clear signal at the expense of a little volume, use a 3 1-2 to-1 on the first stage. The second stage transformer should have a 3 1-2 to-one ratio winding. A potentiometer

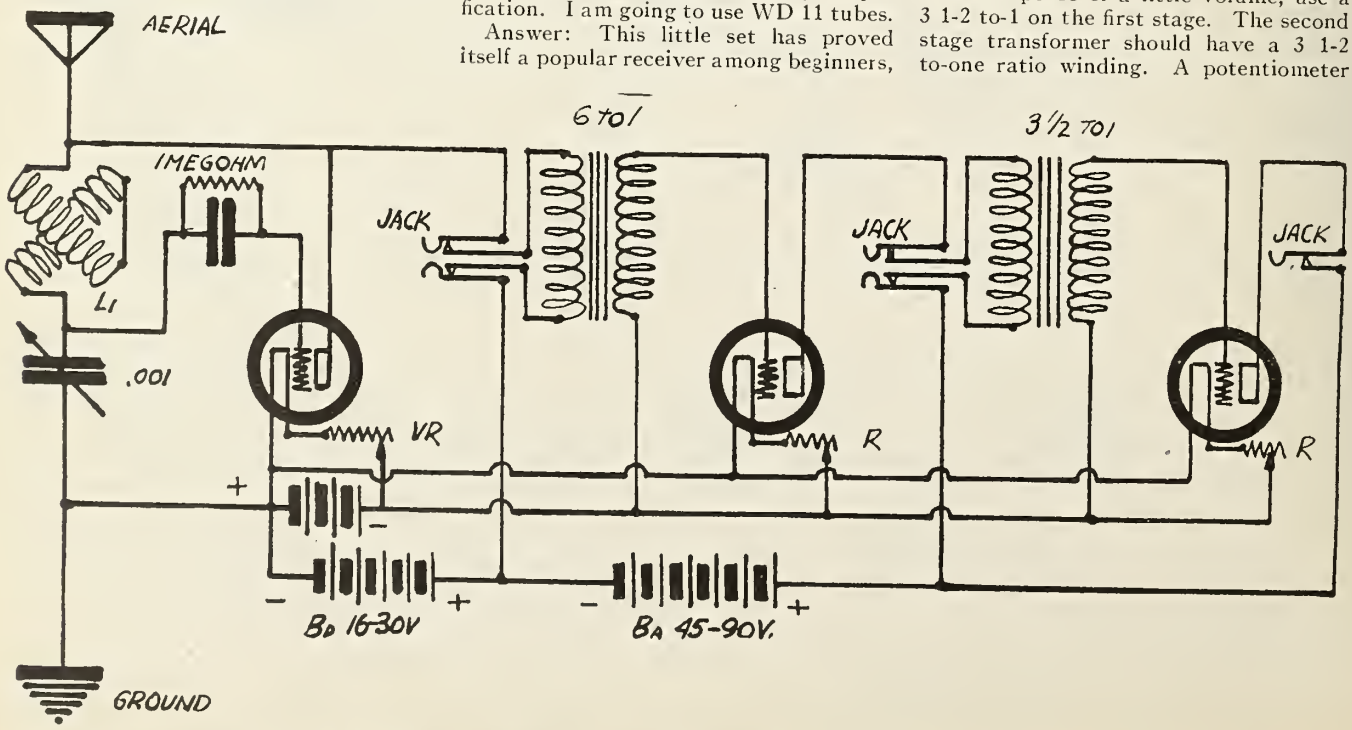


Figure 3. This shows the simple beginners' receiver, connected to a two-stage low-frequency amplifier. If WD 11 tubes are used, the C battery arrangement shown in Figure 2 should be added. If good results are to be expected, the transformers should have the ratio specified on the diagram. This circuit is probably the simplest and most efficient tube set yet developed, taking into consideration the small amount of apparatus used.

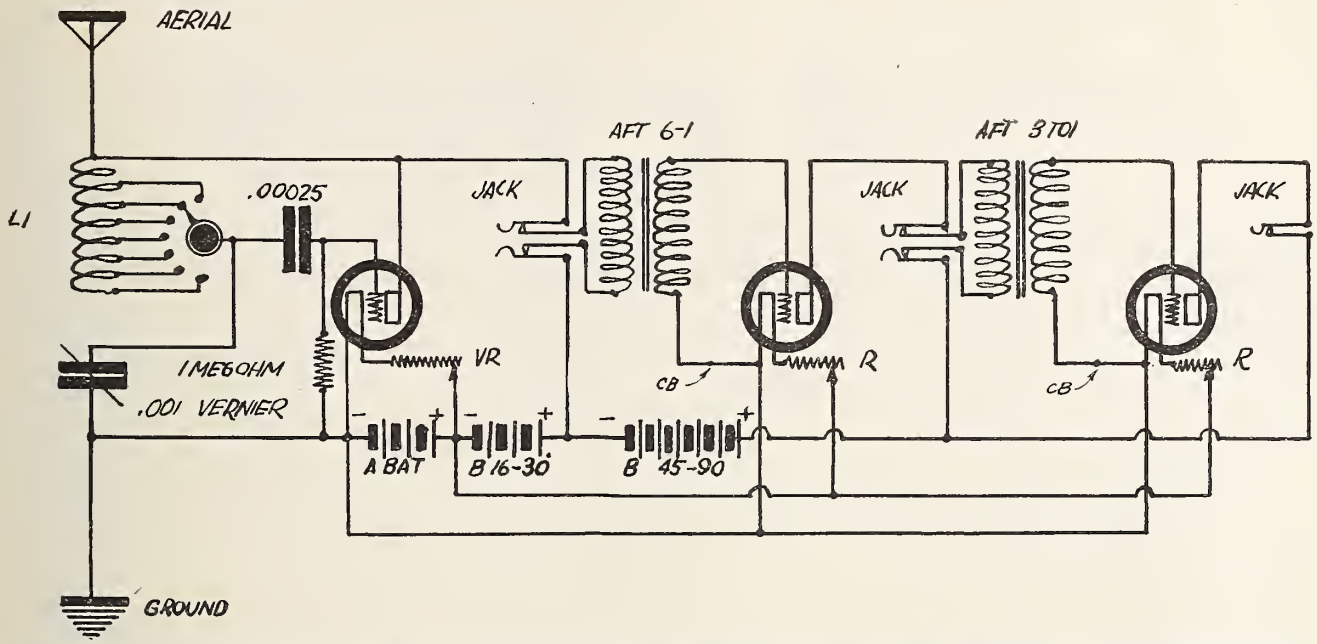


Figure 4. Two stages of audio frequency amplification are added to the Ultra Audion receiver described in the October issue as shown in the above diagram. If WD 11 tubes are used, C batteries should be placed at the points marked CB with the negative side going to the transformer—F. The battery should have a potential of from one and one-half to three volts, and should be used to gain the greatest efficiency from the tube.

having a minimum resistance of 200 ohms and a maximum resistance of 400 ohms will be satisfactory in this circuit.

H. W. H., Long Beach, Calif.

Question: My friends tell me that it is practically impossible to tune out interfering stations with my receiver, which is a set made by a well known manufacturer. If you could proffer any suggestions as to making the set more selective, it would be very welcome. If the set cannot be improved, would like to know if the parts in the set may be used in constructing a more selective circuit. I am not familiar with the reading and executing of circuit diagrams, and would appreciate your favoring me with clear photographs, sketches or other easily understood, not too technical data. Is it true that in assembling a Neutrodyne set that great difficulty is experienced in getting the proper results from the circuit? I am desirous of getting a set that is selective, not too difficult to construct. It is not necessary that it get long-distance, as I do not particularly care for long-distance, inasmuch as many good programs are offered here in Los Angeles.

Answer: H. W. H., we think you are the first fan who has come to us telling us that long-distance reception is not essential, and want to say that here at least is one bug who is trying to appreciate his local station, instead of trying to tune him out. I would suggest that you give the filter and wave trap a trial before you disassemble your receiver, as ofttimes the insertion of this tuned oscillatory circuit will clear up the trouble. The July issue of RADIO AGE contains data for the construction of such a filter. In this (July) issue you will also find an article which will assist you in learning to read and understand circuit diagrams, which will enable you to appreciate the various merits of different circuits. If you are considering changing the circuit you now are using, we would advise your considering the Cockaday circuit, full description of which appeared in the August issue of RADIO AGE. The isometeric drawing of both the Four circuit tuner and the two stage amplifier should eliminate any doubt as to the connections. If you desire to learn what results other readers are getting with the circuit as regards tuning, would advise your referring to the November RADIO AGE, on pp. 20, the correspondence from F. A. F., of Memphis, Tenn.

L. K. G., Cheyenne, Wyo.

Question: I understand that a crystal set may be made more sensitive by the addition of a pote ntiometer and a local battery. Will you show how the con-

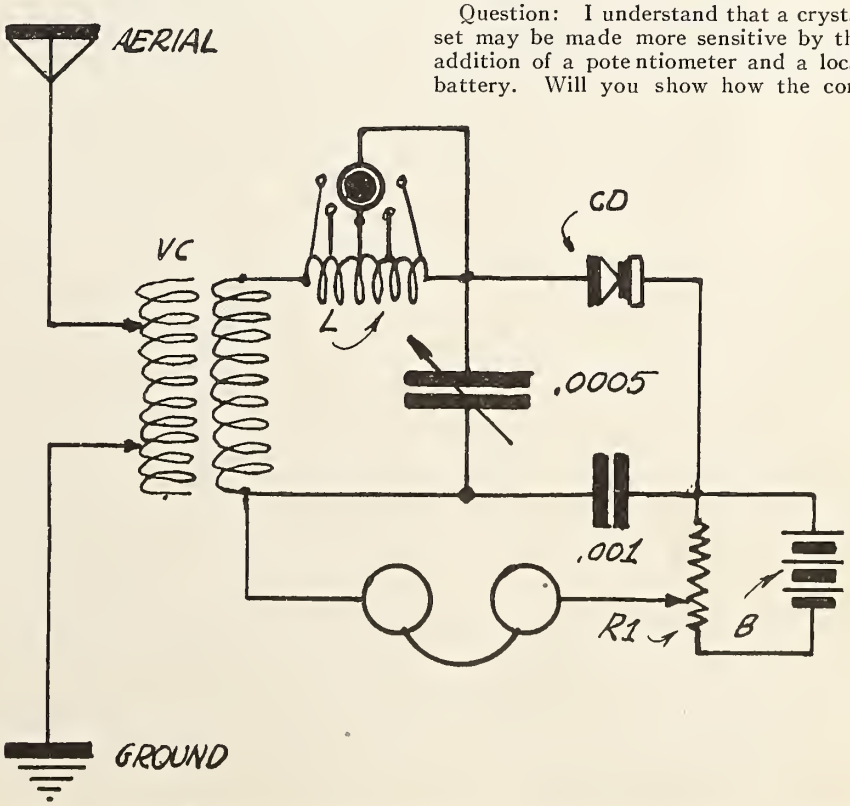


Figure 5. This shows the electrical connections of a sharp tuning crystal set, making use of a potentiometer and local battery to increase the efficiency of the crystal. VC is the variocoupler, L is a coil of 25 turns, tapped every fifth turn, CD is the crystal rectifier, and R1 is a potentiometer of the graphite type, having a maximum resistance of 10,000 ohms. The battery marked B should have a voltage of from two to four volts.

nections for this type of receiver may be made? What resistance should the potentiometer have?

Answer: I am printing in Figure 5 a circuit showing how this arrangement is used. Sometimes a small current passing through the detector circuit makes the set more sensitive to changes in frequency. The idea is an old one, dating back from the time when crystals were used exclusively. The carborundum, zincite and bornite crystals used in sets nearly always required the use of a local battery for this purpose. I have not heard of what results have been obtained when using it on broadcast listening, but the circuit was an efficient one at that time, and I see no reason why it should not prove an interesting experiment for the crystal set user who desires to improve his set.

E. E., Racine, Wis.

Question: I am using a six-volt tube set consisting of a detector and two-stage amplifier, which I operate from dry cells hooked in a series parallel circuit. I find that this method is very unsatisfactory, and I do not wish to purchase a storage battery as I have no means of charging it. My farm is wired, using a 32 volt lighting system, which I know is direct current, and inasmuch as it is necessary to use direct current, I would like to know how to wire up an arrangement to use this source for lighting the filaments of the bulbs. I intend to continue using the Block B batteries for plate potential.

Answer: I am printing in Figure 6 a circuit showing how to wire up an amplifier using the 32 volt lighting system you have. You will need seven resistance units, such as made by the Ward Leonard Company, three of them being of the 22 ohm type and two having 1.7 ohms resistance, and two having 3.5 ohms resistance. The connections must be made as shown or the circuit will not work. This circuit applies only to tubes drawing one ampere or more for filament current. The remaining connections of your receiver will be the same. The small fuse shown in the positive filament lead should be about 1.25 amperes, which will blow out if anything goes wrong, and will save your tubes from burning out. The use of No. 14 soft drawn copper wire is recommended for the filament circuit, with each wire insulated suitably with rubber covering or spaghetti tubing. All parts of the filament circuit should be firmly soldered, so that the resistance of the entire system is not raised.

F. J., New York City, N. Y.

Question: I have built a crystal set such as you described in RADIO AGE for January, and found it to be very selective. All in all, I have constructed about eighteen crystal sets, of all different circuits, but have never been able to get a DX station. I have concluded, after much experiment and reading, that the hookup, aerial and crystal are not of prime importance in the process of long-distance crystal receiving, and contend that it is in the ground connection the secret lies. I have not been able to use a short ground as I live on the top floor of an apartment house. I have a lead from my set to a waterpipe, the wire being about five feet long, but the waterpipe runs around the house for about fifty feet before it enters the ground. I conclude that this makes my ground lead fifty-five feet long, which would be rather long. What is the longest ground lead you have ever heard of? Any information you can give me relative to making the crystal set prone to long distance signals will be appreciated.

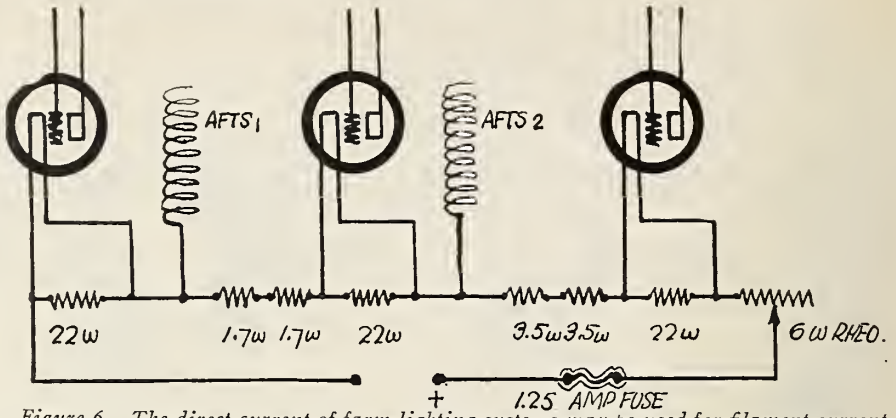


Figure 6. The direct current of farm-lighting systems may be used for filament current if the filament circuit is properly protected with adequate resistances. AFTS 1 and 2 are the secondaries of the audio frequency amplifying transformers of the first and second stages, respectively. The resistances, indicated by the jagged lines, must be placed as shown or the circuit will not work. The rheostat designated should have a resistance of six ohms, and the one and one-fourth amp. fuse shown should be used to protect the circuit, in event anything should go wrong. This circuit cannot be used with tubes drawing less than one ampere, as it will burn out the filament.

Answer: I do not agree with you in the matter of the relative importance of the parts of the crystal set mentioned, and want to point out that the aerial and crystal, as well as the tuning system, are certainly of vital importance in contributing to the over all efficiency of a crystal receiver. The ground lead as you mention is probably just as important as the remaining parts of the set. The success of the entire set depends not upon the relative merits of one specific component, it is rather a matter of the total efficiency of the various instruments and departments of the receiver as a whole. I want to call your attention to the article appearing in the March issue of RADIO AGE, which dealt with the construction of an antenna suitable for use with the crystal receiver of the circuit you mention, and desire to point out that the results obtained using this type of antenna was largely a matter of careful study. The crystal you are using should be of the most sensitive nature if long distance stations are desired, and the tuning component of the set should be constructed with great care if results are to be attained. You might try the use of a counterpoise, consisting of wires strung directly under the antenna, as near to the ground as possible. You might place them in the basement of the house you are living in. The counterpoise is nothing more than another aerial, carefully insulated from the ground, and having as many wires in it as space will permit. The ground post of the receiver is connected to the counterpoise instead of the conventional ground connection. The large broadcasting stations located on top of high buildings, where an efficient ground is not accessible, use this method of obtaining a ground connection with very good results. The same applies to aeroplanes. About the longest ground lead ever brought to my notice was that of an amateur who lived on the twentieth story of a city hotel, who used the waterpiping system of the building for both receiving and transmitting ground. He used a two-tube receiver of the honeycomb type, and a transmitter of the spark type, and queer as it may seem, he obtained very gratifying results.

I would attribute a great deal of his success to the fact that he was located in such a high position that the resistance and the unfavorable conditions due to the use of the waterpiping ground were just about a standoff. However, the success of a receiver, no matter what kind of circuit is used, is dependent entirely upon first the choice of instruments, next the construction and design, and last the character of antenna and ground or other collector system used. Probably one of the most overlooked factors of prime importance is intelligent and painstaking operation.

G. R. Lyons, Iowa.

Question: I notice in your October RADIO AGE, a circuit which was devised by one of your readers, O. Tuck, of Grimsby, Ontario, Canada, and want to say that this is just the type of circuit I am looking for. I would like to know if Mr. Tuck has any trouble in receiving the new wave allocations, and what size of wire is used in the construction of the Reinartz coil. I am using a hookup of the Ultra-Audion type as described in RADIO AGE, and am having very fine results with it. I am using the W D 12 tube. How would two stages of audio frequency amplification be added to this set?

Answer: The September issue contained information relative to the loading of the Reinartz receiver, enabling the operator to easily tune in the higher wave lengths now in use. In winding the coil, use number twenty-six cotton enamel covered wire. I am printing in Figure 4 the connections for a two-stage amplifier with the Ultra-Audion circuit.

Little Things That Help

Tube Socket Unnecessary

Many experimenters have found themselves in a position where everything to make up a set was on hand excepting one of the most necessary (supposedly) accessories. Often this happens to be a tube socket.

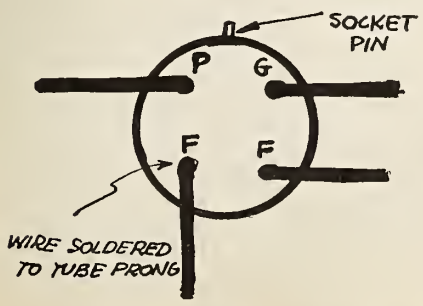
Here is a little scheme which will enable you to forget the added expense of the socket, together with the losses, and at the same time forget about this adapter business.

There are four prongs on the base of all the standard tubes of today. Two of these prongs make contact with the filament of the bulb, and two others go to the grid and plate elements of the tube. With a small flashlight battery, test out the various posts until the bulb lights. You are then making contact with the two filament prongs. Mark them F for further reference. Now on the WD 11 tube, the plate prong is the largest, and therefore the remaining one must be the grid post.

On the other valves which use the standard tube socket, the arrangement is different; so to reduce any doubt as to connections of these prongs, we are printing in Figure 1 the polariates or rather respective values of the prongs of the standard bulb.

Mark all the prongs as shown, and then proceed to hook up the circuit you are working on. Here is where you save.

Instead of making the connections of the bulb to a socket solder them directly on to the prongs of the tube. The contact is positive,



the capacity losses of a socket are eliminated, and there is no chance of anyone "swiping" your bulbs.

If there is a rattle in the phone when it is used as a loud speaker, the trouble may be eliminated by placing a cardboard disc over the diaphragm as shown in the photograph. The cap of the receiver should then be screwed on until the quality of the tone is best. (Kadel & Herbert.)

Even little Johnny, the smallest member of the family would hardly work them loose and throw them on the floor to hear them go BOP!

Of course it is necessary to use a heavy wire to keep the tube from slopping all over the set as soon as it starts to oscillate, and number 12 or 14 hard drawn copper or number 14 copper bus par is recommended.

The tube should not rest on the glass tip, but should be in the inverted position, being held rigid by the stiff wires soldered on to its prongs.

Here is an ideal method of shortening up those connections on that new radio frequency receiver you intend to build. The short connections effected are quite a gain.

Why Burn Your Fingers?

Many are the times when experimenting with a new circuit that the patient, meek, and otherwise silent, radio bug bursts out with a string of invectives, putting an injured finger into his mouth, allowing a soldering iron to roll unheeded onto the floor, all because the variocoupler or coil taps wouldn't solder on to the switchpoints, and the finger was used to put them on while the solder was still liquid.

If you want to save yourself the embarrassment of vehemently voicing your opinions of soldered switchtap contacts, try this simple but nevertheless effective remedy.

Instead of screwing the entire switchtap fast to the panel before you solder the connection, carry out the simple idea of first soldering the wire from the tap onto the small nut of the switchpoint. In doing so, hold the small nut in the jaws of a wide-jawed electrician's pliers, and avoid getting any solder into the threads of the nut. Make a good, strong connection with the solder, and then wipe the surplus flux off with alcohol.

Then take the soldered tap and nut and placing the switchpoint through the hole in the panel, start to turn the switchpoint holding the nut from turning with a pair of pliers. Tighten the switchpoint by taking the pliers (when the switchpoint is as firm as you can get it with your fingers,) and giving the round part of the point a quick twist, which tightens the whole business.

Antenna Facts

By Beverly Dudley, Member A. R. R. L.

A SHORT antenna has the advantage over a long antenna inasmuch as the shorter antenna permits sharper tuning, i. e., the short antenna permits the operator to select the desired station more readily than a long one would. For this reason, owners of short antennae often get results superior to those obtained on a long antenna. For the reception of broadcasting stations operating below 350 meters, a shorter antenna than was formerly used is necessary. It would be a very good idea to keep the total length of the antenna—this includes lead-in and ground lead—under 100 feet so that amateur signals from American Radio Relay League stations may be received as well as amateur broadcasting. For best results the antenna should not exceed 120 feet for broadcast reception, or eighty feet for amateur reception.

Effective Height

Apparently the height of the aerial makes little difference to most radio fans. A very high one will be able to pick up more radio frequency energy than a low one; however the high aerial, beside being able to pick up fainter signals, also collects more static, which may seriously interfere with reception, so that too high an antenna is to be avoided. It is the effective height of an antenna that counts; not always the height above ground, but ten feet above a grounded tin roof, would have an effective height of ten feet, not fifty feet.

Insulators

The antenna wires should be kept as far away from the aerial supports as possible. The antenna insulators should be of a good grade and should be so designed that they do not absorb water, and have low capacity between their terminals. Glazed porcelain insulators are the best with genuine electrose second. Avoid purchasing porous or unglazed porcelain, or cheap imitation composition insulators. Keep the antenna insulators clean and preferably replace them every year; they don't work so well when dirt gets an inch thick on them. The long thin-shaped insulators are better than short, thick ones, as the capacity is much lower. See that the lead-in enters the house through a good porcelain tube, and that it does not touch the house other than at insulated points.

Corrosion

The antenna should be a wire conductor of large area and should be selected with care. Flat copper ribbon, copper stranded cable and large size copper wires are all good. Don't use iron wire that has a mere film of copper plating on it. Copper-plated iron wire is used much, but in view of the fact that copper wire is so cheap, it would be advisable to use number twelve or fourteen copper wire throughout the entire antenna system. Insulation on the antenna wires is beneficial inasmuch as it prevents corrosion to the wires, and does not detract from the general efficiency of the aerial.

Be sure to solder all joints in the antenna. A well designed antenna and ground system contributes materially to successful reception.

Amplifier Advice

USE the proper transformer on a certain tube.

Grind the cores of the transformers, even if they are shielded, separate the transformers about 3 or 4 inches and place the cores at right angles to each other.

Do not apply more than the specified voltage on the plates of the tubes.

Use a lower ratio transformer for the second stage, if the second stage amplifying tube is the same as the first.

Use a five watt tube for the second stage, increase the B battery voltage and use the proper C battery voltage for this tube.

See to it that the proper voltage is being applied to the filaments of the tube.

Make all the connections perfect joints, and well soldered.

See to it that all the connections between the tube prongs and the socket contacts are perfect.

Connect the grid and plate to the proper leads of the transformer, i. e., when the outside lead of the primary is connected to the plate the outside lead of the secondary should be connected to the grid.

Shunt the primary of the first stage with a fixed condenser of about .001 mfd.

Shunt both the A and B batteries with a large fixed capacity, say, .5 mfd.

Have you ever considered how much longer you could use the storage battery before recharging if—

You would not demonstrate the power of the battery by shortcircuiting the terminals and showing the heavy spark you can thus obtain.

You would make perfect connections between the filament leads and the battery terminals.

Never Too Old

Age is no bar to a complete enjoyment of radio program Frank R. Wiley of Malden, Mass., wrote WGY, the General Electric Company station as follows:

"Say, that was a corker last night. I have a single tube set about the size of a cigar box and get most of 'em as far as Chicago. Have had seventy birthdays, so haven't long to stay, but am going to get what I can while the getting is good."

One-Wire Antenna

Recent exhaustive tests with one wire antenna on merchant vessels have demonstrated the practicability of using a single wire for low power transmitting purposes as well as for receiving. Aboard ships this feature would eliminate cost, space and weight. It would make the necessary lowering of the aerials on cargo vessels during loading much easier, and reduce the necessary insulators, wire, spreaders, etc. Also the single wire aerials could be hoisted higher than a three or four wire antenna.

Amateurs who have no facilities or cannot afford to erect masts high and strong enough to carry a heavy four-wire aerial, should find the single wire of considerable benefit when using one kilowatt or less power; for two kilowatt transmission, it is said the single wire antenna is not to be compared with larger antenna.

Most every one knows that the single wire aerial picks up less interference. Its efficiency in transmitting is not quite as great as a four wire aerial, but experts believe the decrease in cost, weight and ease of handling would compensate for loss in efficiency.

The recent tests included the use of both inverted L and T type aerials, and several forms of wire. A four-strand wire cable twisted over a manila rope core was found most satisfactory.

MacMillan's Message

After completing a wide curve across Canada and back over the United States, a recent radio message from Captain MacMillan, in winter quarters in North Greenland, was delivered forty-eight hours later to his secretary in Boston, through the traffic system of the American Radio Relay League.

The message was received in Hartford, Conn., in the early morning by Boyd Phelps of the technical staff of the C. D. Tuska Company. Unable to work amateurs in Boston on account of approaching daylight, he gave the communication to Edwin Adams, advertising manager of QST, who was leaving for that city in a few hours. Upon his arrival, the latter delivered the North Pole message in person.

Due to peculiar atmospheric conditions affecting reception the routing of the message was through Jack Barnsley's amateur station at Prince Rupert, B. C., and thence to the station operated by Glenn West, 7ZU, at Polytechnic, Montana. He tried to give it to amateur station 9BAB without success, but luckily it was picked up by Phelps the first time it was sent.

Silent Night

Chicago woman, on a Monday night, exhibited new radio set to woman guest.

Guest asked: "What is coming in, now?"

Hostess said, "It is silent night."

"Oh, goody!" exclaimed the guest, "I have loved that ever since I heard Schumann-Heink sing it."

With the Radio Manufacturer

New Type Head-phones

Contending that the true index of power of an electro magnetic device depends upon the number of ampere turns embodied in the windings, the Penberthy Injector Company of Detroit, Mich., has departed from the conventional system of using only one or two magnets in their new headset. The new type of phone uses four electromagnets, with each coil wound to 1,000 ohms resistance. The permanent magnets are built up of two laminations. Total resistance of the phones is 4,000 ohms, and each set is matched at a frequency of 800 cycles.

Especial care has been taken in making the phone cords of positive contact and nonbreakable character. The headband is finished in soft leather of dull black finish, and the entire headset is lightweight.

The Penberthy four pole, 4,000 ohm headset has been tested and approved by RADIO AGE experts.

Warren Radio Loop

Extensive tests carried on by the RADIO AGE institute find the Warren Radio Loop to be of merit in the matter of receiving local stations. The loop when tested out at the RADIO AGE Laboratories picked up in less than an hour stations from distances as far as fifty miles with practically the same audibility as that of a regular antenna. The set used in conjunction with the loop was a detector and two-stage outfit, similar to the one shown in the April issue of RADIO AGE.

Tuning with the loop was very critical, the stations being received on just a minute change in the secondary condenser. The loop is a very compact instrument, measuring not over 8x8 inches, and provides connections for wave lengths from 200 to 1,000 meters, by a series of binding posts and jumpers which can be opened and closed to suit the operator.

The instrument should prove a popular piece of apparatus with the amateur who has trouble in getting an aerial erected, or who builds a superheterodyne or other receiver of high-power type where a loop is used.

It was received by RADIO AGE in good condition, and contained explicit printed instructions as to operation and proper use.

Practical Radio Lessons

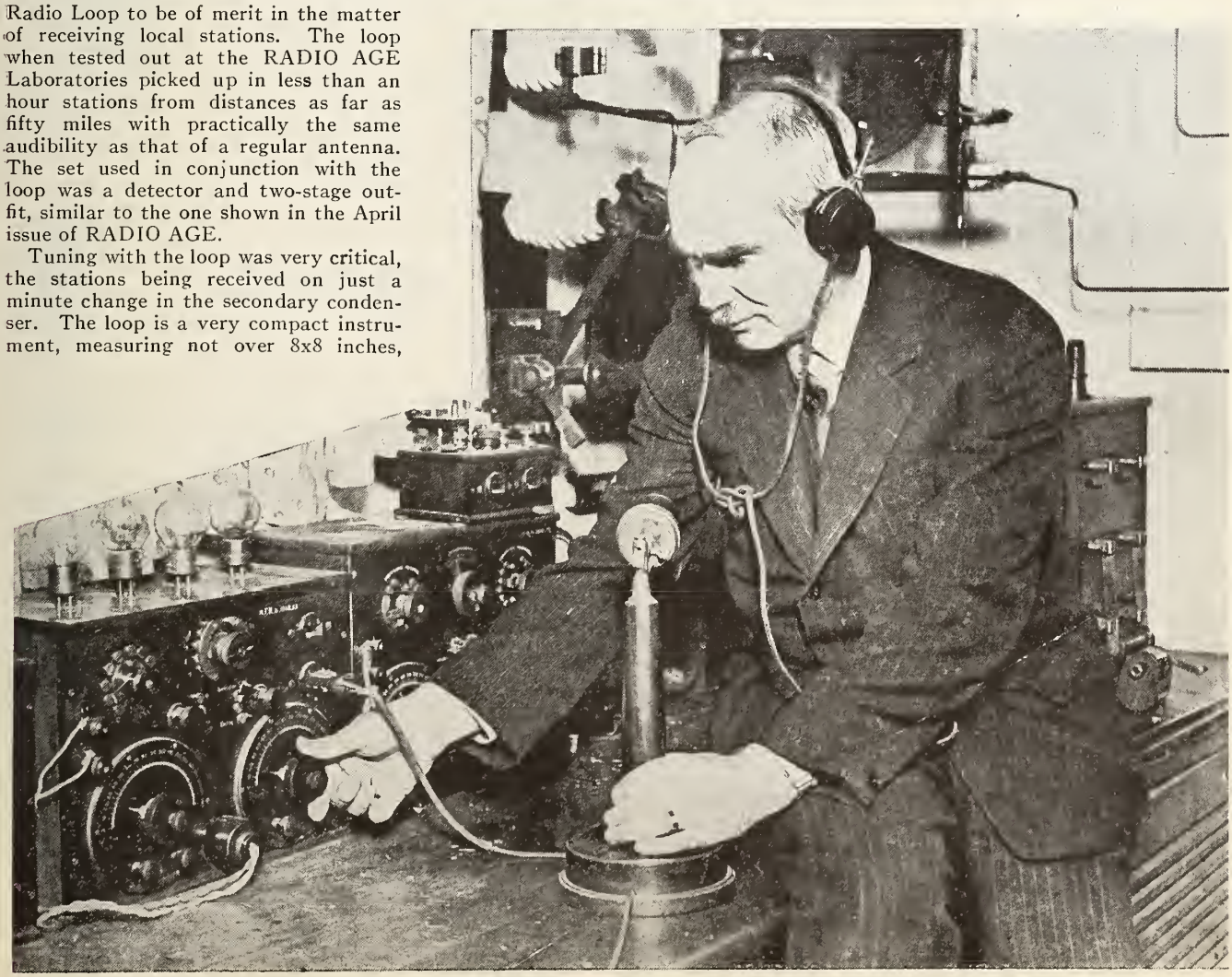
An entirely new and exclusive method of instruction in radio has been formulated by the American Radio Association, 4513 Ravenswood Avenue, Chicago, of which G. A. Mohaupt is engineer. The biggest difficulty in teaching radio by mail was the inability of the student to grasp the practical as well as the theoretical side of the subject through the means of charts and pictures alone. The American Radio Association gives with its course,a radio outfit ready for, wiring. The student is taken step by step through all the phases of radio. He works on an actual radio set and his education, therefore, is of practical value. He is not given mere book learning but he learns by actually doing. Many graduates of the American Radio Association earn considerable money during their spare time by constructing and installing radio sets for their friends and neighbors.

Applause Card

One of the hits of the Radio Show held in New York during the week of October 6 to 13, was the distribution from the booth of the Dictograph Products Corporation of envelopes containing five applause cards.

These cards have been received with the greatest enthusiasm by the radio public, as it gives them for the first time, in a simple form, a means of showing their approval or disapproval, as the case may be, of the programs being rendered by broadcasting stations.

The applause card was originated by the Dictograph Products Corporation.



Dr. Lee DeForest examining radio equipment on the S. S. "Paris," on which ship he returned recently from Europe. (Kadel & Herbert.)

Hints on the Adjustment of Radio Receivers

By L. W. CHUBB

Manager of Radio Engineering Department, Westinghouse Electric & Manufacturing Company

RADIO broadcasting should be governed by rules and etiquette which will enable everyone to get the most enjoyment from it. We hear many people speak of the invisible audience, but how many visualize this audience and appreciate that others in the audience have any effect on their own results or that they, in any way, affect the reception of others.

The fisherman or the golfer obtains equipment best suited to his individual needs, and learns to use it effectively by instruction or experience. He may or may not interfere with the pleasure of other sportsmen. He is expected to follow a code of etiquette. In the theater large hats are removed in consideration of those behind; at the ball game a "down in front" is forthcoming if one interferes with the vision; and in the town meeting we do not put up with the noisy individual in the audience who interferes with his neighbors by radiating his opinions.

After a slight consideration of each one's part as a member of the radio audience, it will be appreciated that corresponding conditions exist and that radio receiving must be played as a gentleman's game.

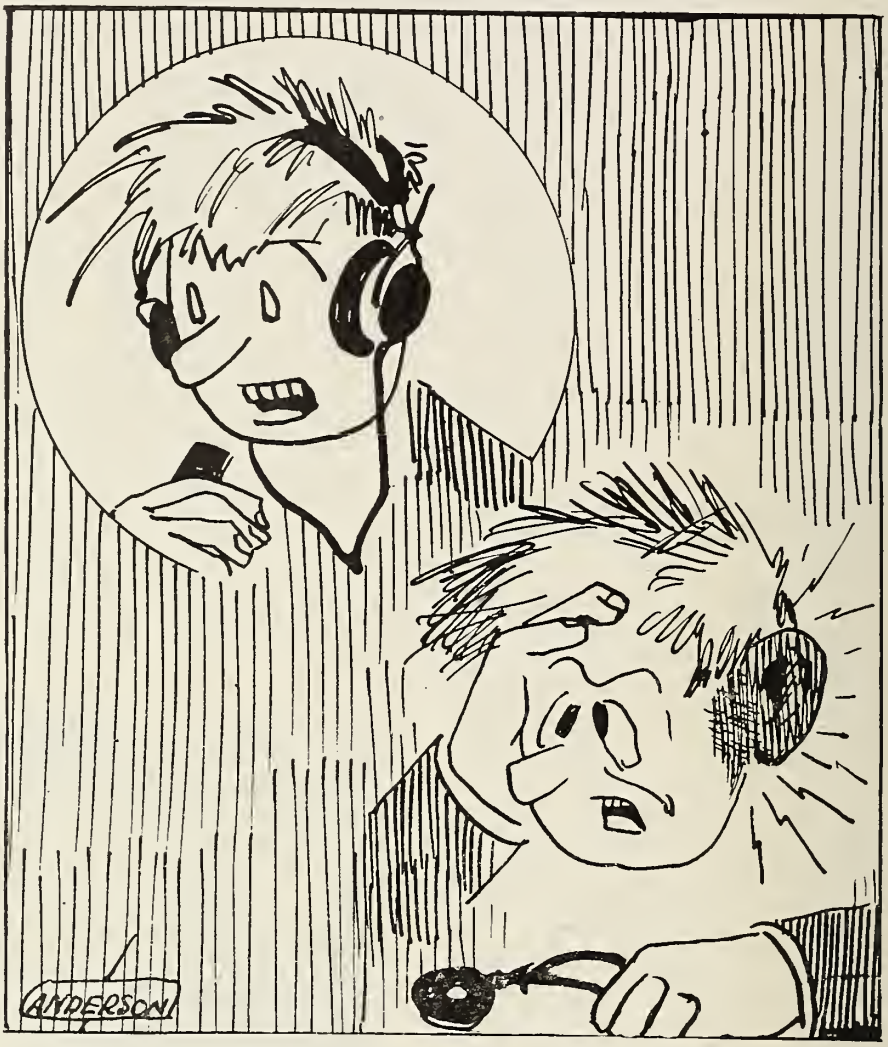
The Wireless Shadow

A radio receiving station consists of some form of antenna connected to a radio receiver of one of several types. The antenna intercepts the wireless waves and absorbs an amount of energy dependent upon the size of the tuned antenna and the conditions of operation of the radio receiver. The waves induce currents in the antenna circuit which reradiate energy from the antenna. Each station then takes from the passing waves an amount of energy equal to the difference between the energy intercepted and that reradiated. It is evident, therefore, that each station may cast a sort of wireless shadow and thus reduce the strength of signal left for those in the back seats of the vast audience.

Our great auditorium, unfortunately, has the cheap seats in front. Around each broadcasting station are thousands of listeners using crystal receivers which require the most energy, re-radiate the least, require the largest antenna, and therefore cast the greatest shadows beyond.

An important hint therefore in the operation of a crystal receiver is to de-tune the instrument when it is not in use. This does not mean that the adjustment of the crystal need be disturbed—merely move the tuning adjustment to one extreme or the other. An antenna out of tune casts no shadow.

In addition to the crystal receivers in our radio audience, there are thousands of vacuum tube receivers used at various distances from the transmitting station. These fall into three general classes: The simple tube set without regeneration; the regenerative receivers; and the receiver with radio frequency amplification, usually working with a loop antenna.



Chewing gum while listening-in with the phones clamped tightly to the ears, results in the ears assuming a shape much related to a cauliflower and imparts to the jaw a delicate tinge of black and blue.

The first, or simple tube set, owing to its lack of sensitivity, can be used effectively only within a short distance of the broadcasting station. This type of set is usually simple to operate, requiring only the adjustment of tuning after the filaments of the tubes have been lighted.

The regenerative receiver is the most common set in use and, on account of its high sensitivity and selectivity, when properly used will be found to be the best all around radio receiver. It is this type of receiver that I particularly wish to refer to. Many operators attempt to use such an instrument with the same large antenna that was used with a crystal set, and thereby lose the advantages of the receiver.

They wonder why the receiver picks up several signals and apparently will not select one alone. The trouble is with the antenna. The sharp selective tuning of a regenerative receiver can be taken advantage of only with a small antenna. It is not necessary to use a double circuit receiver to obtain satisfactory results and prevent interference.

Nearby Broadcasts

Theoretically, with a small antenna the same strength of signal can be obtained at the best point of adjustment of tuning and regeneration. Practically, the adjustments can be made so close that no appreciable signal is lost and the sharpest of tuning is obtained. If one is troubled by the reception of two or more nearby stations at the same time, a small indoor antenna should be used across the top of the room or of the room above.

This will allow the separate selection of signals, unless they are on almost the same wave length, and, with little practice in adjusting the instrument, distant signals can be picked up readily and satisfactorily. To obtain the best results with the regenerative receiver the operator should use only the pre-

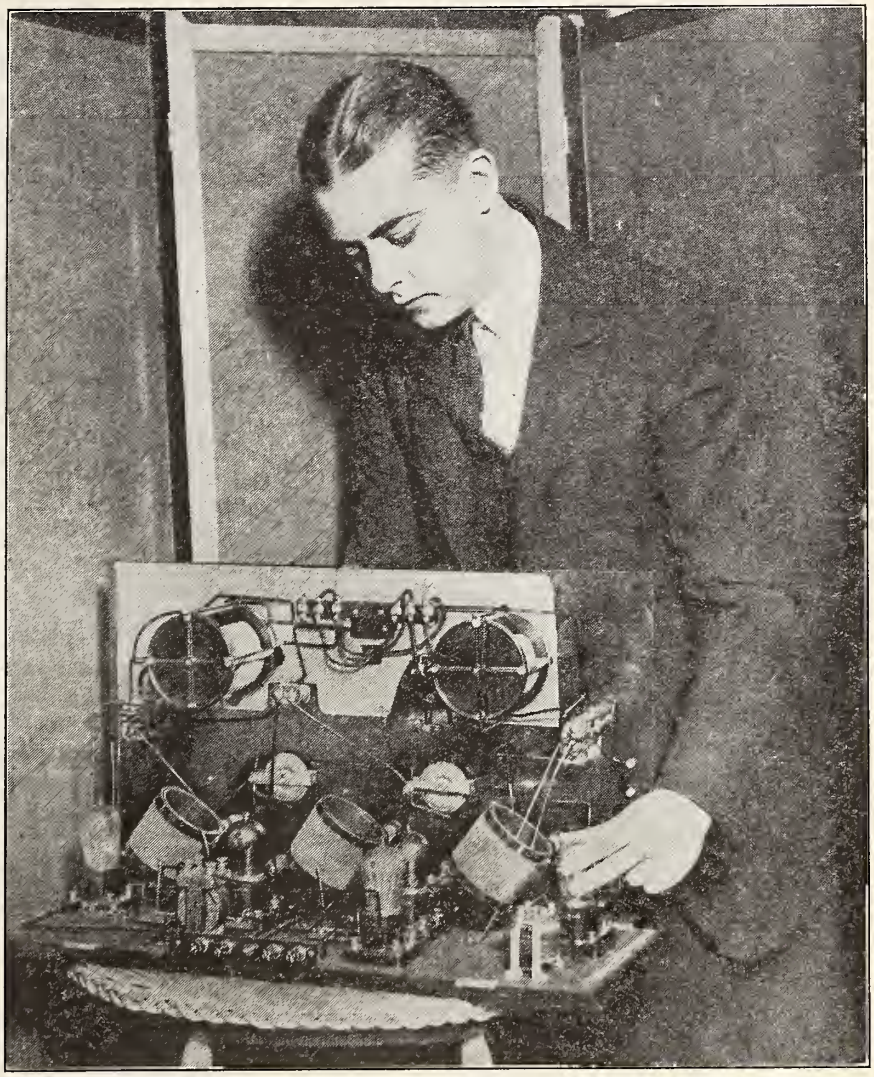
ferred methods of adjustment, and I wish to call attention to some of the important things to be considered in the operation of this type of receiver.

Most of the users of the regenerative receiver know that it has an Armstrong circuit, and that by the adjustment of a "tickler," "intensity regulator," "plate variometer," or "regenerator," whichever it may be called, the signal can be increased greatly. They know also that at a certain point the detector will commence to oscillate and the receiver will omit whistling noises or beat notes, as they are called, when the tuning is run through an incoming wave. Few of those using this type of receiver, however, know that these whistling noises can be heard in a neighbor's receiver and that similar noises which are heard when a set is not being adjusted are caused by a nearby receiver improperly adjusted.

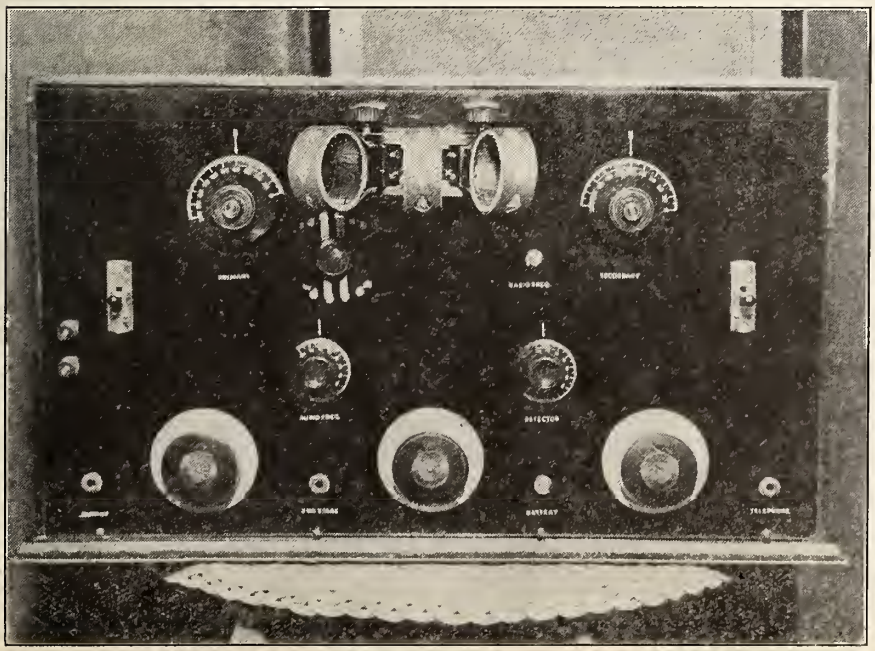
As regeneration is increased the amount of reradiation from an antenna increases until, at the point just below oscillation, the reradiation is equal to the absorption, the loudest clear signal is received, and the receiver neither disturbs a neighbor nor absorbs any appreciable energy, which can pass on to the more distant listeners.

Booster Stations

The most common infractions of radio etiquette are the use of regenerative receivers while oscillating and the hunting of signals by picking up the carrier wave with the detector tube oscillating. Most radio operators have found that by careful adjustment the "beat note" can be lowered in pitch to a central point where the noises stop and a signal can be heard with the tube oscillating. This adjustment is known as the method of "zero beat reception." Under this condition, a receiver radiates more energy than it absorbs so that the station can be considered as a booster station which will reinforce a passing radio signal. If such booster stations were properly located and the adjustments could be made so as not to produce any distortion, this method of receiving might help reception conditions. This, however, is not the case and zero beat reception should be avoided.



Rutledge R. Mayo and his combination honeycomb coil and neutrodyne radio set. It consists of a three-circuit honeycomb set for long wave reception and a neutrodyne set for short wave reception, all mounted on the same panel. The same tubes are used for either receiver. (Kadel & Herbert.)



A closeup of the combination three-circuit honeycomb and neutrodyne set. (Kadel & Herbert.)

It will be found that the quality of signal is greatly impaired under this condition of adjustment. It is evident also that getting in and out of the "zero beat" adjustment will cause disagreeable noises in the neighborhood and even when the adjustment has been obtained many snorts and grunts are produced by the slightest change in the wave length of either the transmitting station or the receiver.

In hunting signals it is a common practice to have the detector tube oscillating and then, after finding a carrier wave, to lower the regeneration to a point below oscillation to clear up the signals. This practice disturbs others who may be tuned to the same wave and is an unsportsmanlike procedure that ruins their enjoyment of radio broadcasting.

The Proper Method

I should like to suggest the following method of receiving broadcasting programs with regenerative receivers. After adjusting the filament currents of the vacuum tubes to a point which has been found to be satisfactory increase the regeneration to a point just below oscillation. Now tune the set slowly up or down the scale, keeping the regeneration adjusted just below oscillation until the desired signal is heard or a breathing sound is noticed, indicating the presence of a carrier wave from a station which may not be operating at the instant.

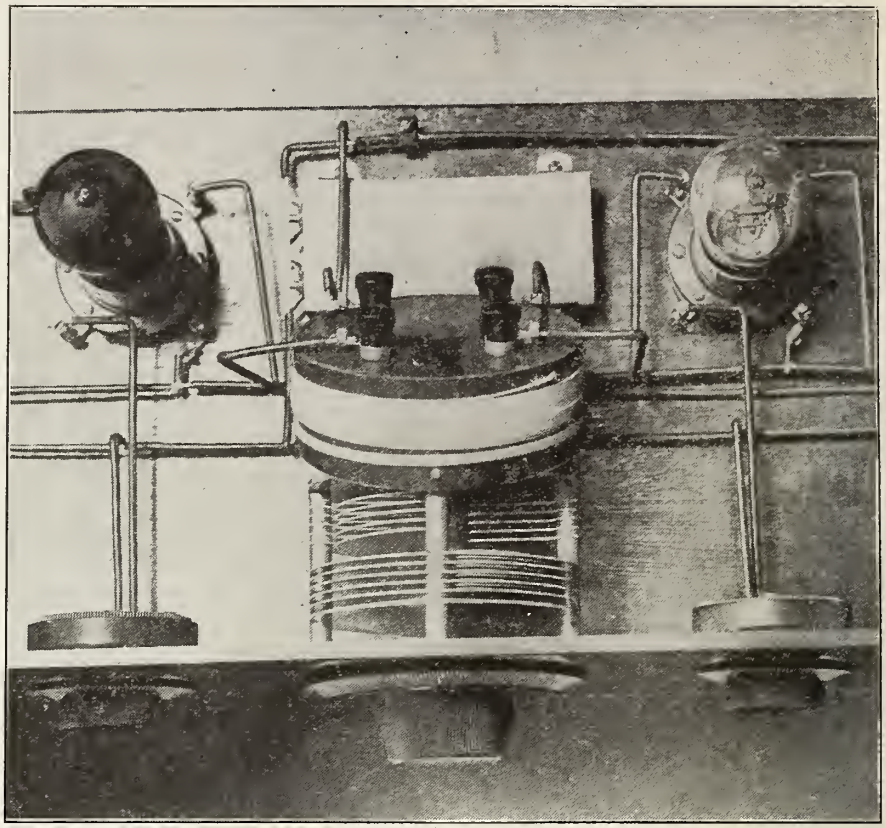
If the receiver is well designed the adjustment for regeneration will be practically the same throughout the range of broadcasting wave lengths and any worth while signal can easily be tuned in, after which the volume can be increased by a final adjustment of the regeneration.

You will soon be able to pick up signals just as easily by this method as you can by the beat note method. If everyone will hunt signals and listen to the music with the detector tube adjusted in this way, the quality of broadcast programs will be very much improved. The gurgling, rough, and distorted music which is now heard, in a large part is due to the reradiation from many oscillating receivers, will disappear. The whistling noises which go up and down the scale, due to a neighbor's hunting signals with an oscillating receiver, will be eliminated. The steady screaming notes which are heard at or around the signal from a broadcasting station are due to interference between two or more broadcasting stations and cannot be eliminated until a great number of these stations are closed up or are given individual and separated wavelengths.

Chile Is in Line

Another step was taken in the development of radio-telephony in Chile recently when for the first time a conversation was held between a private broadcasting station, belonging to a Chilean amateur in Vina del Mar, on the Pacific Coast, and Tucuman, Argentina. The Vina del Mar station was distinctly heard in a radio club in the latter city at midnight, whereupon conversation was kept up for over an hour. A few days later, conversation was established between the Chilean coast and Buenos Aires. Musical programs from the Vina del Mar station were also clearly heard on board vessels traveling along the Chilean coast.

The number of Chilean amateurs has been growing for some time and not a few have installed apparatus in their homes. Attempts to commercialize radio interests have been rare and half-hearted heretofore, but a strong business organization has been formed in Santiago under the firm name of "Compania Radio-Chilena," for the purpose of installing an up-to-date and adequate broadcasting station on the roof of Santiago's single skyscraper, the "Edificio Ariztia."



Another tuned radio frequency picture. The radio frequency transformer's location with reference to the condenser is plainly shown. Walter S. Lemon, the designer of this outfit, gets distance with a loop aerial. (Kadel & Herbert.)

Jack Barnsley

Prince Rupert, B. C.—Starting off with a queerly constructed homemade radio receiver that would be the laughing stock of the most uninitiated present day radio fan, Jack Barnsley of this place now has a high power amateur station that has made him the only connecting link between the Arctic explorer, Captain Donald D. MacMillan, and the whole civilized world.

Beside being peculiarly well situated to receive messages from the little schooner, "Bowdoin," in winter quarters at Refuge Harbor, he has a radio receiving set and antenna installation that compares favorably with some of the best stations in the United States.

It was sometime in 1910 that Barnsley thanked his lucky stars for the good fortune that had brought him a Bell telephone receiver, a dry battery, a couple of carbons and a hatpin with which to build his first radio apparatus. He made his coil from some stray wire, headphones from the single receiver, a detector from the carbons and the steel needle, sharpened to a fine point, for the movable part.

A few years later and Barnsley was working for the Marconi Company as a wireless operator on coastwise steamers, finally on board the "Empress of Russia" when he visited Japan, China and Manila. A recruiting sign for the Royal Air Force attracted his attention in 1917 and there followed a "hitch" as instructor in the army.

Since he established communication recently with the Artic vessel after weeks of complete silence, he has received scores of messages from members of MacMillan's crew and sent them on to relatives and friends in the states by means of the traffic system of the American Radio Relay League, of which he is a member. He uses an improved type of regenerative receiver with two-step audio amplifier.

Radio Jumps Mountain

Radio is being used successfully in India to send messages over a mountain 15,000 feet in height. Previously, considerable difficulty was found in wire communication due to heavy snowdrifts and storms which severed the lines. This achievement has been effected between the cities of Srinagar and Jammu, in Kashmir. Other installations have been effected or are planned in Bhopal, Gwalior, Hyderabad and Rejkot, by Marconi engineers, Trade Commissioner Spofford reports to the United States government from Calcutta.

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How to Copy Wireless Code Signals

By FELIX ANDERSON

Technical Assistant Radio Age, and Kendall North, Radio 9BDL

Installment Two

ASSUMING that you are now so familiar with the sounds of the various code characters of the radio telegraph alphabet, that when the sounds DAH DAH DAH DAH di DAH are issued you will recognize them as O. K. within a reasonable time limit, we will proceed with the next steps toward making you a proficient operator as far as code copying is concerned. If you find that you are having trouble in recognizing the various letters, we would advise your spending a little more time and effort on them, as in this case, a little too much is a great deal more beneficial than not enough.

Now that you have the accents, sounds and construction of the code character firmly placed in mind as a musical sound, the next step will be to familiarize yourself and train your arm to repeat these combinations with a key.

You will now need a few pieces of apparatus; namely, a key, buzzer and source of power. The key should be chosen with care, and we would advise that you do not purchase a makeshift affair, inasmuch as from our experience we know that you will undoubtedly "fall" for the transmitting game sooner or later, once you have learned the code, and then you will agree with us that it is certainly *dididAHdit DAHdididit*, (FB or fine business) to have a creditable key handy. The buzzer can be purchased from your local hardware store, or can be of the high-pitch type, which is procurable at any radio store. If a high-pitched buzzer, sometimes called high frequency buzzer, is used, it will be necessary to use direct current from a local storage battery, but if an ordinary buzzer is used, the 110 volt house lighting current, stepped down by a small toy transformer may furnish the juice. A key which is very popular with the amateurs, called the Boston key, can be procured at almost any good radio store which handles transmitting apparatus.

Selecting the Tone

Connect up the apparatus as shown in Figure 1, and then proceed to adjust the buzzer for the best tone. A smooth, soft, easy to read, tone is the best, and the ear of the person using the apparatus can best judge this. The high frequency buzzers usually have an adjusting screw provided for changing the note of the buzzer, but the plain house buzzer, of the type procurable at the hardware store, will take a little closer adjustment for a nice note. This may be accomplished by placing a few pieces of fine paper between the armature or vibrator

Figure 2. This illustrates the correct position of the hand when sending. The wrist should not touch the table, and the heavier muscles of the forearm should do the work, the finer touches being made by the more delicate muscles of the wrist and fingers.

pieces, to take any harsh sound away.

After you have adjusted the buzzer to the best tone, the next matter will be to set the various screws provided on the key to suit your individual fist. The key should just have enough tension or spring to bring it up with easy break, but should have sufficient spring to make smooth sending possible. The best key adjustment will be found after a few hours' practice. The spacing should be just a little less than 1-32 of an inch, or sufficiently wide to prevent arcing of the contacts.

Get yourself seated in a comfortable chair, at a table or other firm support, that is plenty wide to allow you to place your entire arm from the elbow down on the table. With the index finger and middle finger placed loosely but firmly on the key, with a slight curve press the key down firmly, and then release it. The key when released should follow your fingers back to the original off position.

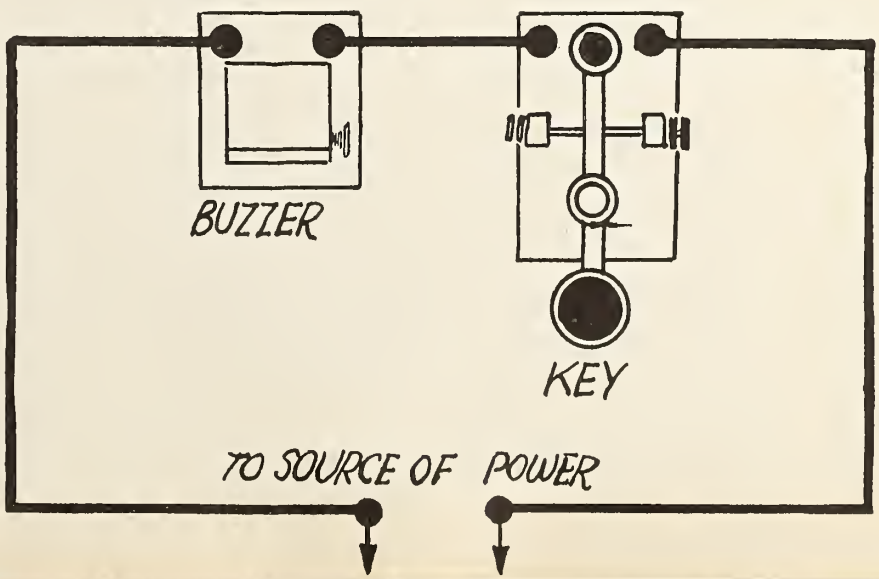
If it does not, the key is needing a little more spring, and should be adjusted to assure smooth working. When adjusting the key, the signal dididiDAHdit or the word "test" is usually sent, and if difficulty is experienced in snapping off the dits smoothly, the key should be so arranged that it becomes possible to do so. The entire forearm should be relaxed, and the fingers, while firm, should touch the knob lightly. The habit of sending with the forearm relaxed should be cultivated, inasmuch as sending with the arm "cramped," or rigid, will result in what the amateurs dub "glass arm" or "pumphandle fist."

Starting to Send

Take a piece of newspaper, choosing some item of interest, which contains some numbers and all the letters of the alphabet, and putting yourself in the frame of mind of an operator of a high-power long-distance station, with thousands of receivers tuned in on your wave, start to send PX (press), consisting of the newspaper item you are sending from. If you come to a dollar sign, spell out the word dollars preceding the number. If you come to a comma, omit it, and when you encounter the end of a sentence, merely make the space between the last word of the preceding sentence and the first of the next sufficiently long to show appreciable difference from the spacing of the words.

When you are sending, see to it that at no time your fingers touch the metal of the key. There will come a time later when you will have about 100,000,000,000,000 volts or more passing through the key circuit, and the sensation is not one of pleasure, when direct contact is made. Don't forget to use the wrist movement.

Send slowly—If you speed up your



transmitting before you really know how to handle the key, you will only acquire jerky, ill-spaced sending, and nothing will be accomplished. Make your dashes three times as long as your dots, and longer if you find trouble in making the sending smooth. The dits or dots should be snapped off with a quick movement of wrist and fingers combined.

A word as to the proper accent of the individual characters as they appear in a word or sentence is probably the next thing to be considered. Between some characters such as S and H and T and M or O, the space will have to be somewhat emphasized to prevent the combination from being confused. The spaces between the letters of a word, should be about one-third of that of the spaces between words, and the spaces between the words of a sentence should be about a third of the space between the spaces separating the sentence. We will once more call your attention to the proper accent of the DAH components of a character, namely in the case of the letters C and N. The letter C should be sent *DAHdiDAHdit*, making the characters sound as a part of one letter, while the combination N N should be sent *DAHdit*——DAHdit with an emphasized space between the two letters. One can readily see how this precaution will prevent the sound from being confused. In any case where this double combination appears, this rule applies, and it also holds for characters where a series of dots or dashes composing the characters of a letter appear in close sequence. By all means, send slowly, as slow sending always results in the proper formation of the characters, and later develops into a smooth, easily read "fist."

Correcting an Error

If you make an error in transmission, the proper way to correct it is to send *didi DAHDAH didit*, the sound for the interrogation point, and then to repeat the entire word in which the error was made. The old way is to send a series of fast dots in quick succession, but among amateurs the interrogation method has almost entirely superseded this method.

One of the reasons we emphasize the fact that one should not send faster than he can receive, is explained by the tradition among amateurs that the person with whom communication is being carried, will, if he is a good operator, not send any faster than the one with whom he is talking.

Give yourself plenty of practice with the key, as it will assist you immensely in copying signals later on. About a week of practice for a starter before attempting to copy regular transmission over the air is a good plan, as you will then be more likely to recognize any errors in your sending. After you have worked out this phase of code learning to your own satisfaction, the next step will be to proceed with the interesting business of

Actual Code Copying

It will probably appear to the reader who has started the business of learning him through a great many unnecessary preliminaries, but we want to assure you that every one of them is vitally necessary in the course of the making of a good operator. This next step is the real test of how much you have applied yourself to the foregoing procedure, and is also a test of your patience, perseverance and application.

Scare up that piece of paper you used in the first steps of learning the code, and get yourself a pencil to copy with. We will assume that you have a receiver capable of tuning down to 200 meters, and that you know almost exactly where the amateur "offenders(?)" come in.

Before we go further, we want to tell you right now, that you shouldn't be disappointed if you can't copy everything that comes through the receivers—there are times when the most expert of us can't do it. Some of the traffic going through is snapped off at a mighty lively rate—about twenty-five or thirty words a minute—and you have to step kinda lively to cross your T's and dot your I's when copying. But on the other hand, you can always single out some fellow who is going along at a rate more your size, and that is the one you should start on. At any rate, don't let yourself become disappointed—here is where the real trial comes in.

Choose one of the signals of code that is going at a speed that enables you to recognize some of the letters as the sending goes along. Tune the signal in to the loudest point, and then start to put down just what you hear. Copy the letters as they come in, reading about two or three letters behind the sending, i. e., you should acquire the habit of reading slightly behind the key.

By this we mean that you should be putting down the letter you heard two or three letters back while you are reading the ones that are being sent. If you find that this is too far advanced for you then merely listen hard, putting down the ones that you recognize.

Copying Calls

The best practice for this is to listen to some station calling, inasmuch as when a station is calling another, the transmission rules require that the one calling shall send the call of the one being called three times followed by the sign DE and then sign his own call three times. This it can be readily seen offers much chance for the beginner to correct mistakes in copy, and get the entire transmission correct. Calls will probably be the first code signals you will be able to recognize, and therefore you will probably start to find it interesting. If when you are listening to this process of calling, you miss a letter, copy the next one—don't stop, as when the call is repeated you will be able to put in the missing letter.

As you progress with your receiving speed you will find yourself copying signals that are meaningless as far as making sense out of your copy is concerned. You find that you have the entire transmission correct as you know that you have written down just what you have heard, but when it comes to make any sense. So before we lure you any further into this mysterious business, we want to let you in one some of the traditions, abbreviations, conventions and procedures used among the code listeners and senders.

What is Said in Code

First of all we want to tell you that the United States is divided up into nine radio districts. Briefly, we will tell you how these subdivisions come:

FIRST DISTRICT:

Has its headquarters at First District Customs House, Boston, Mass. It includes the states of Maine, New Hampshire, Vermont, Massachusetts, Rhode Island and Connecticut.

SECOND DISTRICT:

Headquarters at the Custom House, New York, N. Y., and comprises the counties of New York, Staten Island, Long Island and those on the Hudson River, including Schenectady, Albany, and Rensselar of the State of New York; also the counties of Bergen Passaic, Essex, Union, Middlesex, Monmouth,- Hudson, and Ocean of the State of New Jersey.

THIRD DISTRICT:

Headquarters, Custom House, Baltimore, Md. It comprises all of the counties in New Jersey not included in the above list; all counties south of the Blue Mountains in Pennsylvania, the states of Delaware, Maryland, Virginia and the District of Columbia.

FOURTH DISTRICT:

Headquarters at the Federal Building, Baltimore, Md. The fourth district includes the states of North Carolina, South Carolina, Georgia, Florida and the territory of Porto Rico.

FIFTH DISTRICT:

Headquarters at the Custom House, New Orleans, La., and is composed of the states of Alabama, Mississippi, Louisiana, Texas, Tennessee, Arkansas, Oklahoma and New Mexico.

SIXTH DISTRICT:

Headquarters, Custom House, San Francisco, California. The states of California, Nevada, Utah, Arizona and the territory of Hawaii compose this district.

SEVENTH DISTRICT:

Headquarters at the Federal Building, Seattle, Wash. The seventh district comprises the states of Oregon, Washington, Idaho, Montana, Wyoming and the territory of Alaska.

EIGHTH DISTRICT:

Headquarters at the Federal Building, Detroit, Mich. The Eighth District comprises all the counties of New York not included in the second district; all the counties of Pennsylvania not included in the third district, the states of West Virginia and Ohio and the lower peninsula of the State of Michigan.

NINTH DISTRICT:

Headquarters at the Federal Building, Chicago, Ill. The ninth district comprises the following states: Illinois, In-

diana, Wisconsin, Minnesota, Kentucky, Kansas, Missouri, Iowa, Colorado, South Dakota, North Dakota, and the upper peninsula of Michigan.

By referring to the above list you can tell what radio district you are in.

The calls of amateur stations are arranged in alphabetical order, classified under the various districts. Thus, if you hear 1CNI you can tell that you are listening to an amateur in Massachusetts, or in the first district. The government when issuing liscenses allots a call to each station. These calls are classified in the order of from what district they come from, and are listed in call books similar to a telephone book. Thus if you hear the call, you can readily look up the fellow and find his address.

Ship, naval, commercial and other stations are listed in another call book. Copies of either book may be had by writing the Superintendent of Documents, Bureau of Printing, at Washington, D. C.

Q Signals

International agreement provides for what the amateurs call "Q" signals. A copy of this set of international signals is printed hereafter in this article. The use of these signals is to cut down the verbosity of asking commonplace questions as to operating conditions, traffic, etc., and make the transmission more speedy. When the signal QTC is heard it means "I have a message for you," and reversed or rather interrogated thusly: QTC? it conveys the sentence: "Have you a message for me?" When the signal QRZ is sent, it means "your signals are weak here," and when interrogated QRZ? it reverses the idea and asks "Are my signals weak?" One can readily see how this speeds up the interchange of thoughts concerning the existing operating conditions. We would recommend that every code learner memorize the following Q signals, as they are nearly always used: QTZ? QSR? QSA QRK QRS QSL and any others as the need comes, but the ones above mentioned are sent through the air many times in a day, and therefore to understand what is going on, you should know them.

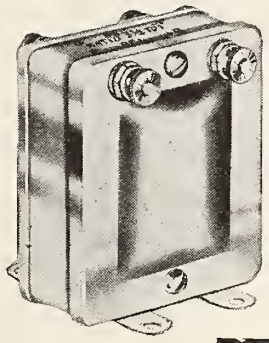
"Ham" is the term applied to the amateur who is interested in the business of sending code signals. In his everyday life in radio, he makes use of a lot of snappy signals to convey his thoughts over the air, which to the average reader would not mean much. Allow us to explain.

Taking an extract from some of our own pieces of copying, it runs something like this:

tks fr QSR om ur FB hr vy QSA and stedy nm hr nw so best 73s c u agn sk.

Could you understand that? No? Neither could we when we started, and every time we heard some new abbreviation we had to run around and get some OM to help us out in the matter of decoding it. Taking the first part of the above extract: tks means thanks, fr means for, QSR relaying, and om means "Old Man." Old Man is a term used among amateurs in transmission, and is significant of the spirit of good will and friendship existing between amateurs. So you see, the whole thing put together into real language would mean: "thank you for relaying that message for me, old man"; and the remaining transmission when decoded would read:

"Your signals are fine business here. They are very loud and steady. Nothing



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"Radio" Want-ads

more here now so best regards, will see you over the air again," (sk) end of transmission.

That's the way the amateur talks over the air. It's almost a language of its own, and to let you on the fun of the game we are printing some of the commonest abbreviations used among code operators:

The signal di di DAH di DAH for O. K.

73 for Best Regards.
wlom for Well Old Man.
k for Go Ahead.
Sk for finish of transmission.
hr or er—here or hear.
ka—attention.
no soap—for nothing doing.
tnx, tks, tku—thanks, thank you.
es—and.
msg—message.
tfc—traffic.
cul—see you later.
c—see.
gg—going.
u—you.
r—are.
ur—you are, your.
oic—Oh I see.
rcd, r—received.
abt—about.
min—minute.
fixt—fixed.
wl—well.
om—old man.

dg, yl, ow—refers to a young lady operator, namely dear girl, young lady, or old woman as the case may be. The term ow is only used when the two persons talking are very well acquainted.

lstn—listen.

QST—stand by and listen. Copy what I have to say.

fm—from.
eo—to.
spk—spark.
cw—continuous wave.
becuz—because.
arrl—American Radio Relay League.
tt—that.

The signal diDAHdi di dit means wait. The signal DAH di di di DAH is the signal sent while thinking, illustrated thusly:

er nr 12 fm chgo eo (address)
(and then the signal —...—)
crd. recd. taks. wl qsl.
sg
9DQS

sg—signed.
QSL—acknowledged.
chgo—Chicago.
NY—New York.
crd—card.

There are many other abbreviations and forms of spelling words for which no rules can be formed. In code, the quickest, simplest and most effective way possible is u s e d in conveying thoughts. No rules for spelling, tense, or other grammar exists excepting in the transmission of reports, commercial messages and other formal business.

The amateur laughs over the air when something funny is said or done by sending Hi hi hi or mim mim or else ha ha. More than once we've experienced the razz when calling a sixth district station with a quarter KW spark set, and when we reset the antenna switch for receiving were suddenly overwhelmed by a host of hi's, ha's and mim's coming from about fifty local stations due to the futility of trying to work about 2,000 miles with 250 watts spark. As the amateurs say over the air at times "tonk" or "Awf." We think that this is a pretty good starter on abbreviations for you to acquire, and want to say that you have at your command more pleasure in using them than any amount of jokes you can spill verbally on your friend Bill.

We want to show you what just a bit of amateur "chewing the fat" going through the air is like and print the following taken from the logs of the stations of the writers. (By the way a log is a record of the business of the station, the calls heard and any other interesting items.)

We will take our own specific call letters and enact a little chat over the air:

CQ CQ CQ de 9BDL QTC CQ CQ CQ de 9BDL k (That's 9BDL saying that he wants somebody to relay a message for him.) CQ is the general call. Here's someone calling him.

9BDL 9BDL 9BDL DE 9DQS 9DQS 9DQS GE QSR QRV 9BDL 9BDL 9BDL De 9DQS 9DQS 9DQS k.

(That was station 9DQS calling 9BDL saying good evening, I am ready to relay the message for you.)

R 9DQS de 9BDL r ok er nr 1 fm hr eo john smith 1234 western st., los angeles cal bk crd rcd ltr follows with dope on cw set. pse qsl. sg kn 9BDL hw l? 9DQS de 9BDL k (9BDL giving the message to 9DQS and asking how he got it.)

R 9BDL de 9DQS ok 1 qrv 2 9BDL de 9DQS k.

(9DQS saying number one is O. K. and for him to go ahead with number 2.)

r 9DQS de 9BDL tks sa om if u c dorothy tell her no soap abt tt dance nxt satrday. gess nill nw QTC? 9DQS de 9BDL k.

(9BDL acknowledging receipt of message by 9DQS and asking him to do a personal favor for him. He then says he has no more traffic to handle and asks 9DQS if he has any further messages to handle.)

r 9BDL de 9DQS OK art om nm hr nw so c u 1 73 sk 9BDL de 9DQS k.

(9DQS saying all right old man, nothing more here now so will see you later, best regards, and signalling end of transmission.

73 sk 9BDL.

(9BDL announcing his willingness to sign off) usually followed by the signal di dit from the station last talking telling other stations who may be waiting to go ahead.

This, however, is just one of the most common examples of the type of transmission going on right over your head, and does not show you the pleasure derived from listening to stations from all over the world, listening to reports of wrecks, disasters, steamship distress signals, etc., but even then, it is fun to know what the other fellow is doing so that you cannot understand it.

We sincerely hope that the foregoing pointers will help many fellows who desire to become real honest-to-goodness radio bugs on their way to understanding more of the mysteries of the radio game and we hope that at some time we may have the pleasure of conversing with some of our readers over the air through the medium of code, as taught through the columns of RADIO AGE. We want to tell you that if there are any further details that puzzle you with regard to copying the code, we shall be pleased to answer them for you through the regular service in RADIO AGE'S Troubleshooter department.

Gess nm hr nw so hope to wrk u over the airsumtime best 73's.

SK de 9DQS es 9BDL.

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Please send me FREE one of your Reinartz Radio Books and send me Radio Age for ..... I want to take advantage of this Special Offer. I enclose .....

Name.....

City.....

Street and Number.....

Enthroned by Radio

THE engagement of Señorita Carmen Fernandez Ramos, Cuba's beauty queen, has just been announced, thus providing a climax to a series of unusual triumphs, and proving the potential value of feminine charms backed by loyal friends.

Four months ago this orphan girl was poor and obscure, her perfect Cuban type of beauty known only to her fellow-operators at the long distance switchboard of the Cuban Telephone Company in Havana. Today, because of that beauty and because of those fellow-operators, she is one of the most stylishly-gowned women in the Cuban capital; she has $8,000 in cash; is soon to marry Havana's exclusive photographer of the wealthy and the socially prominent, and her name and features are known in North America from Atlantic to Pacific.

When El Mundo, one of Havana's leading newspapers, offered a $5,000 prize for the prettiest girl in the Republic, the telephone operators decided to back their charming comrade against the formidable field. And it was formidable, for Cuba producers at least as many pretty girls to the acre as any country on earth.

The Cuban Telephone Company operates Broadcasting Station PWX, the chief source of entertainment of the thousands of radio fans in the Island, and with a voice which, incidentally, is heard in every state of the Union and throughout Canada. The operators decided to conduct their campaign by radio.

Other candidates used old-fashioned methods. But they could not compete with the Radio Girl. Carmen was elected Beauty Queen of Havana by a majority of 100,000 votes. Meanwhile, the curiosity of radio fans in the States and Canada had been aroused, and there came numerous requests for her pictures from publications and from individuals.

As the selection of the prettiest girl of each province was to be made from photographs by a jury of Cuba's best known artists, Señorita Carmen's operator friends determined to take her to pose before the camera of the socially-favored specialist in feminine portraits, Joaquin Blez, than whom there was none more excellent.

Attired in a Parisian gown by Mme. Cumont, the handiwork of the gay Cuban capital's foremost French modiste, and the first fruit of her victory in the Havana contest, Señorita Fernandez Ramos climbed the stairs to the Blez Studio. She presented a decided contrast to the Cuban telephone operators, in their uniform attire of white shirt waist and blue cotton skirt.

In his career, Señor Blez had surveyed the feminine charms of Cuba's socially select with an impartial, professional eye, until he might have been adjudged immune to any irregular heart action due to the visions of loveliness that frequently glided across the huge polar bear rug in his reception room. Just at the moment, he was photographing a member of the chorus of the New York Winter Garden.

But when Señor Blez stepped to the door of his reception room, and his eye rested upon the exquisite features and form of the telephone girl, enhanced by the Parisian gown, the disinterested professional glint faded forever from his eye, as far as that particular señorita was concerned.

There was something more than pride of his art that Señor Blez put into that job. His friends admitted that he had outdone himself. The jury of artists returned a quick and unanimous verdict. Señorita Fernandez Ramos was named the fairest exponent of feminine pulchritude in the province; subsequently she won the title of Beauty Queen of Cuba, and with it the $5,000 prize.

Then the Havana City Council, out of tribute to the capital's fair daughter, voted $3,000 to enable her to buy a home.

Havana's leading department store, inspired with the beauty contest spirit which by this time had the Paris of America in its clutches, put up a selection of its best gowns as a prize, and announced a new contest. There was a gigantic window display of the photographs of contestants—and there was also a delicately hand-colored pastel of Señorita Fernandez Ramos, by Blez.

The customers of the store took one look at the portrait in which the heart of the artist had directed his skilled hand, and cast their votes for Carmen. She won the gowns.

Last of a series of brilliant social affairs came a charity ball at the Teatro Nacional. All Havana was there. It was a brilliant display of gowns and jewels, not to mention the array of beautiful women.

Señorita Fernandez Ramos led the grand march, on the arm of Señor Fontanills, Havana's social dictator. As she walked into the spotlight glare behind a battery of movie cameras, she came face-to-face with a full length and almost life-sized pastel portrait of herself. The name of the artist in the corner was Blez.

The Beauty Queen has posed for other Cuban artists. Of course, she has been approached by the movies. She has been put forward as a candidate in the international beauty contest at Nice. Various other offers have been made to her. But she continues working for the Cuban Telephone Company, among the loyal girl friends who fought her victorious campaign.

If your newsdealer has sold out his supply of RADIO AGE you are likely to miss just the hook-up that you have been looking for. To avoid any such chance fill out the coupon in this issue and send in your subscription. Then you will be safe. And don't forget that with each subscription at the special price of $2.00 a year, or $1.00 for six months, we send you free the popular Reinartz Radio booklet FREE. Address Radio Age, 500 N. Dearborn Street, Chicago, Ill.

Charges Radio and Auto Batteries at Home Over Night for a Nickel

For a friend who owns a radio set or auto, what would be more appropriate than a gift which would eliminate the inconvenience and expense of taking his battery to a service station every time it requires recharging? The

GOLD SEAL HOMCHARGER

is such a gift, appropriately dressed up in a beautiful package. It charges any Auto, Radio or "B" storage battery in the quickest, simplest and most efficient manner possible. Connects to any lamp socket—operates silently—requires no watching. Fully automatic in operation—absolutely safe. Beautifully finished in mahogany and gold. Unqualifiedly guaranteed. Over 125,000 already in use.

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It's your guarantee against substitution and appears on name-plate and package. No other charger is just as good.

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Largest Manufacturers of Vibrating Rectifiers in the World

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6 Volt, 11 Plate, Ford, Cher. Hup. Buick Cleveland, Duant $11.50
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12 Volt, 7 Plate, Maxwell, Dodge, Franklin, $16.00
OTHER SIZES ON REQUEST

RADIO BATTERIES

2 volt for W.D.11&W.D.12 tubes run 300 hours on 1 charge..... $4.00
4 volt for U. V. 199 $7.55
6 volt 60 amp.hr. $7.90
6 " 80 " " 8.85
6 " 100 " " 10.60
6 " 120 " " 12.10
6 " 150 " " 14.50

All batteries are fully guaranteed in writing and shipped subject to examination. Send 10 per cent. with order, balance on arrival. Deduct 5 per cent. if full cash accompanies order. Shipped same day order received. Act now.

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OPERATE A LOUD SPEAKER ON ONE TUBE

We have a new wonder circuit that will efficiently work your loud speaker on a single tube on local stations. Over 2,000 miles have been covered loud and clear with phones. Parts are few and inexpensive. Easy to build. Send 25c for hook-up and complete instructions.

Leumas Radio Laboratories, 311 Fifth Ave., N. Y.

PICKUPS AND HOOKUPS

By Our Readers

COMPARING results is one of the most entertaining diversions offered by radio, outside of listening. That next morning post mortem on what stations were heard the night before is undeniably one of the joys of being the proud owner of a radio set. When you hear Havana or POZ or some other distant station, you know that the other fellow will be interested in knowing how you did it, and you naturally pass it on to the other bugs, being as modest about it as you can. That's the kind of spirit that keeps the game going. That's the way it started. If everybody were selfish and kept his results a dark secret, the game wouldn't move very fast.

Therein lies the keynote of the popularity of the *Pickups By Readers* department. Every day we get many letters from readers telling us how they feel about this and that circuit, offering improvements and kinks, and sometimes challenging the other readers to "raise" their record for pickups. If this spirit of generous good will and good natured rivalry is continued there will be an increasing interest in radio. We want you to feel free to write this department, when you accomplish something or have some little improvement or other that would be interesting. You use the questions and answers department when you are having trouble—why not let the *Pickups By Readers'* department hear from you when your set is doing its darndest.

C'mon BCL's! Let's have your lists and pet kinks.

THE EDITOR.

Last month we featured letters from those who were getting results from the Cockaday circuit described in the August issue, and immediately we get letters from fellows using Reinartz, Erla and other circuits who good naturedly remark with a shrug of the shoulders "that's nothing, listen to this one:"

RADIO AGE,

Gentlemen:

I have been interested in noting your "*Pickups By Readers*" for the November issue. The fact that 1,000 miles reception on a two-stage Cockaday or Reinartz has been considered good performance impels me to report results obtained with my set. This is also a two-stage Reinartz set, using power tubes, in the conventional two stage transformer coupled amplifying circuit.

I experience no difficulty in tuning out our local stations WWJ and WCX, and picking up out-of-town stations. We receive stations as far distant as 1,250 or 1,300 miles so well on loud speaker, that they can be heard in the flat below us, and on the street, also. Los Angeles (2,451 miles) and Havana, Cuba (1,500 miles) come in nearly as well, except that their tuning is very sharp. I tune in most long distance stations without the phones on—using a loud speaker unit on my victrola.

My set is "homemade," using an outside antenna of three wires only thirty-five feet long, and about twenty-five feet from the ground, and in a relatively poor location, inasmuch as it is surrounded by trees, telephone wires, and power lines.

The results I have secured make me a staunch Reinartz enthusiast and I would recommend it to anyone desiring a good moderately priced circuit.

What were the long distance receptions you mentioned in connection with reception by W. Lehr of Chicago?

Very truly yours,
L. E. TREADWELL.
1051 Baldwin Ave., Detroit, Mich.

This letter makes R. R. C. (the Reinartz Radio Circuit) advance a couple of points in the field of radio circuits. Mr. Treadwell makes quite clear that the Reinartz is a consistent long-distance getter. With reference to Mr. Lehr's record: Mr. Lehr sent us a list 'way back in January at the beginning of the year, which we published in the January-February number, and the day after RADIO AGE came out, the postman staggered in through the door with a load of letters from fellows inclosing lists of stations heard on their Reinartz sets. If you want to get a line on what some of the other fellows accomplished with this circuit take a peek back into the March, 1923, issue of RADIO AGE.

Back in May we published data relative to the construction and operation of the Erla reflex circuit. Just glance at this and see what it did for one of RADIO AGE'S regular readers:

RADIO AGE,

Gentlemen:

I have read quite a number of excellent "Pickups" in RADIO AGE and some of the fellows certainly have been going some. Now I don't feel like I have accomplished wonders, but let some of the BCL's, especially those who want volume read over these:

On Saturday night, October 13, between 9 and 10:30 p. m., the following stations were heard through an Art Mache unit with a die cast wood horn loudspeaker, connected to the single tube Erla reflex circuit constructed by myself, with the aid of RADIO AGE. All the following stations were heard clear and distinctly, and with enough volume to be heard throughout a large room: WGY, WJZ, WTAM, WOC, WOAW, WOS, WFAA and WHAS, my local station.

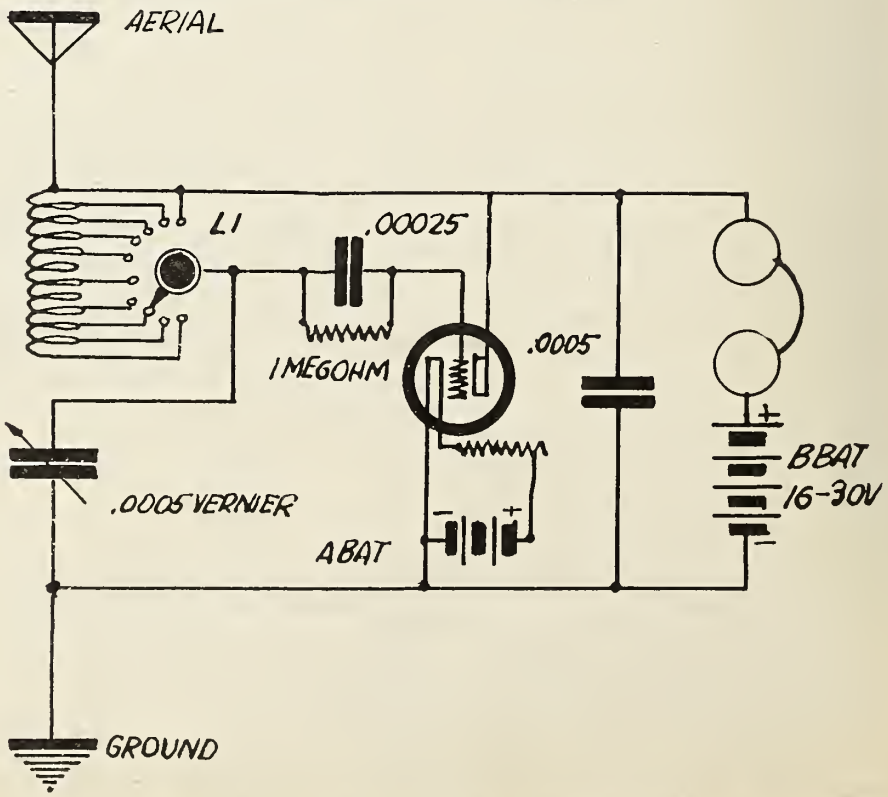
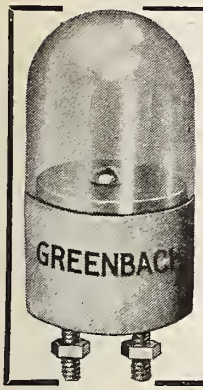


Figure 1. This shows the circuit constructed by one of our readers, which is giving unusual results. L1 is a spider web coil, having 10 taps, with taps at every seventh turn, making the coil 70 turns in all.



AT LAST!
GREENBACK FIXED DETECTOR

No more indistinct sounds. No time wasted finding sensitive part of crystal. Greatest improvement on market. FOOL-PROOF, DUST-PROOF, TROUBLE-PROOF. Used wherever a crystal detector is part of circuit. Get one today! Pin dollar bill to this ad with name and address and get it quick postpaid..... 98c

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LEARN RADIO

Here's your opportunity. Radio needs you. Win success in this fascinating field. Trained men in demand at highest salaries. Learn at home, in your spare time.

Be a Radio Expert

I will train you, quickly and easily, to design, construct, install, operate, repair, maintain, and sell all forms of Radio apparatus. My new methods are the most successful in existence. Learn to earn

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FREE Wonderful, home-construction, tube receiving set, of latest design. Write for "Radio Facts" free. Engineer Mohaupt.

American Electrical Association
Dept. 4?2 4513 Ravenswood Ave., Chicago

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Six cents per word per insertion, in advance. Name and address must be counted. Each initial counts as one word. Copy must be received by the 15th of month for succeeding month's issue.

HELP WANTED

750 men—boys 18 up wanted immediately to prepare for U. S. Government Positions, Railway Mail Clerks, City Mail Carriers, Post Office Clerks, Income Tax Examiners; $117 to $250 month. Steady work. Short hours. Paid vacation. Influence unnecessary. Write immediately—today—for schedule of examinations. Franklin Institute, Dept. E114, Rochester, N. Y.

FOR SALE

For Sale: DeForest OT-20 transmitter, complete, good repair; also 100 watt Radio Corporation set with kenotrons. Address, Radio Station WCAJ, University Place, Nebraska.

FREE HOOKUP

Sixty-thousand miles on Home-made Receiver. Twenty-six hundred mile range. Hundred-station log and Hookup free. Spencer Roach, 2905 Columbia Avenue, Philadelphia, Pa.

BOOKS

If you have not bought your Reinartz Book, fully illustrated with hook-ups and clear description of how to make this popular circuit, send $2.00 in money order or currency and we will send you the booklet "Reinartz Radio" and place you on the subscription list of Radio Age for one year. Address Radio Age, 500 N Dearborn Street, Chicago, Ill.

PANEL SHIELDING

Don't let Body Capacity interfere. Use our panel shielding which is applied to any set in five minutes without removing instruments. Price 35c. H. & M. Specialty Co., Box 66, Brighton, Mass.

If your newsdealer has sold out his supply of Radio Age you are likely to miss just the hook-up that you have been looking for. To avoid any such chance fill out the coupon in this issue and send in your subscription. Then you will be safe. And don't forget that with each subscription at the special price of $2.00 a year, or $1.00 for six months, we send you free the popular Reinartz Radio booklet FREE. Address Radio Age, 500 N. Dearborn Street, Chicago, Ill.

For the BCL who wants volume (some of them do not seem to be able to get a loud enough signal) this is the set. With the head set, the range is from coast to coast. I am partial to my Reinartz with two stages of audio, which by the way has been heard over two blocks on the speaker above mentioned, my Cockaday for selectivity — but when I want volume, especially in hot weather, I resort to my little Erla reflex.

The BCL's who are not subscribers to RADIO AGE should certainly be, for the hookups and data given in your wonderful little magazine are plainer and more easy to understand than those of any other magazine.

Very truly yours,
J. H. JONES.
Crestwood, Ky.

Reflex circuits are sometimes hard to get adjusted correctly, and there are very few of them that can be worked out very well by the average enthusiast, but we knew that the Erla was a good one, and therefore we printed the data concerning its construction and operation. That the set can do its stuff is certainly made plain in Mr. Jones' letter. We want to extend our thanks to him, and are glad to learn that the Reinartz and Cockaday circuits also are giving the proper results.

Here's a chance to settle that ever prevailing question of "how much should I pay for a good readio set:"

RADIO AGE,
Gentlemen:

I am sending you a hookup of a small set with which we are having fine success, and which may be of interest to some of your readers.

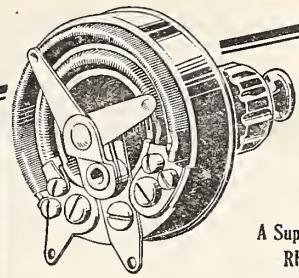
In this set, instead of using a tuning coil, we use a spiderweb coil of seventy turns of No. 18 S C C, with taps at every tenth turn. With it we can get all stations on the new wave lengths, clearly and with surprising volume.

Some of the stations we have logged are: KSD, WLW, WSAI, WHAS, WJAX, WWJ, KDKA, WCAE, WEAF, WGY, WGR, WLAG, WMC, WSB, WHB, WFAA, WBAP, WOAW, WOC, WRM, WJAZ, WPAD, WDAP, WMAQ, KYW, WIAS and others.

This set, using all reliable material, can be built and installed at an expenditure of not over $25. I might add that this set was constructed by my son, who is fourteen years old.

Very respectfully yours,
HENRY W. LEMBERGER.
2037 Osborn St., Burlington, Iowa.

This letter ought to settle the question as to what kind of set to build for some of our beginners. If a set can be built at so small an expense, and get stations as well as this one does and at the same time be so simple that a mere boy can build it then it must be a pretty good one. Mr. Lemberger has all the reason



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A Super Vernier Rheostat

100% EFFICIENCY

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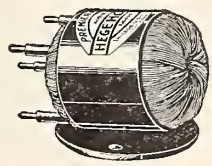
"MICROSTAT"

Trade Mark

There is no substitute for the Premier "Microstat"—no other instrument that gives such perfect control of the current delivered to the filament of radio tubes. New principle—two windings in parallel—one 6 ohm—other 40 ohm. Absolutely noiseless. Infinite control—handles any tube—Cap. 3 amp. Bakelite moulded—silver etched dial. Do not install a rheostat until you know all about the "MICROSTAT." Our Bulletin No. 92 explains it in detail. Send for it. It's FREE.

$3.50



Cut one-half actual size

Pat. Pend.

HEAR THEM ALL CLEARLY

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Audio Transformer

Little but mighty—a wizard for volume and tone quality. Look at the cut. It shows the "HEGEHOG" one half actual size. "Small," you say. Yes, but inside this "Little Wonder" you will find more efficiency, more reproduction volume, and less distortion than found in any other Transformer, regardless of size, price or design. The secret is in its patented construction. It is shielded 100% against foreign noises. Full guaranteed. **Ratios 1 to 3, 1 to 4, 1 to 5, $3.50; 1 to 10, $4.50.** You'll want them in your next "hook-up," so get all the facts NOW. Our Free Bulletin No. 92 gives them fully. Send for it.

Ask for and insist on "HEGEHOG" and "MICROSTAT" at your dealer's.

Premier Electric Company

3803 Ravenswood Ave., Chicago

in the world to be proud of that embryo radio engineer of his.

Mr. Lemberger enclosed the circuit shown in Figure 1. This circuit is of the Ultra-Audion type very similar in construction to that described in the October number of RADIO AGE on page eight.

B. F. Odell, of 270 Ogden Street, Orange, N. J., writes:

RADIO AGE,

Gentlemen:

My RADIO AGE for October has not come to hand as yet. Please don't let me miss it. You gave us a layout for a Reinartz hookup in the May issue of the AGE. I finished it some time ago, and want to tell you that it is a peach! I am getting stations from coast to coast. Have lots of visitors to see it and HEAR it. It certainly is the best ever.

That's where the Reinartz boosters put another notch in their cabinets. We are glad you informed us that your copy of RADIO AGE did not come, and we want to tell our readers to notify us of changes of address, and also if RADIO AGE is not received regularly, so as to keep our card files up to the minute.

E. L. Landell, of Shelbyville, Ill., writes enclosing the following list of stations heard on a circuit of his own design:

On October 1, 1923, 7:30 to 10:30 p. m.: KSD, WBAP, WMC, WSB, WGY, WOS, WCAE, WHAZ, WOAW.

On October 2, 1923, 6:30 to 7:45 p. m.: WDAP, WGY, WBAP.

October 4, 1923, same time: WHB, WSB, WFAA, WOAW, KDKA, WJAZ.

October 5, 1923, 7:15 to 9:30 p. m.: WMAQ, WHB, WBAP, WCK, WOS, WDAF, KYW, WFAA, WMC, WGY, KSD, WPAD, WDAP.

Mr. Landell further writes:

"Anyone wishing a copy of the circuit may write me at Shelbyville, Ill. The circuit is of my own design, using the regenerative principle."

Mr. Landell is one of those fellows who ought to learn the code. We'll bet you can't tell us what the programs from any of those stations were. But who does when they are radio golfing? Your eardrums swell out like a football from the intense listening for the call, and as soon as the call is down on paper, the set is detuned and you are looking for more DX. At any rate, Mr. Landell did some fast tuning work. He must have a calibrated set.

Homer L. Jones, of 216 Euclid Avenue, Sioux Falls, S. D., writes:

"I am using a Reinartz with splendid results. I pick up fifteen to twenty stations most any good night. Get them from coast to coast and from San Antonio to the Canadian stations."

That's the Reinartz again. We've said enough about that circuit for this issue. We wouldn't be surprised if some fellow wrote us and told us about hearing a fly crawl on the wall down at the Havana, Cuba, broadcasting station, and add—I did it with my little Reinartz!

If your landlord is one of those fellows who threatens to raise your rent ten dollars for the privilege of putting up a radio antenna, or is one of those pessimists who contend that a wireless system "draws" lightning, you can fool him after you have taken the following hint:

RADIO AGE,

Gentlemen:

I don't know if my dope is of any use or not, but if you want to publish it in RADIO AGE, I am very glad to let you use it. It will, I know, help a great number of radio fans who live in buildings where they are not allowed to put up an outside antenna.

I have a Reinartz circuit, which I built from drawings in RADIO AGE for September, 1922, which consists of a detector and two stages of audio frequency amplification. With an outside antenna, I received a great number of out-of-town stations. When the warm weather came, I took my aerial down thinking to make some changes in it, but instead of putting up another outside aerial I did some experimenting with an indoor antenna.

The room my set is located in is about ten by fifteen feet. I took a single strand of bell wire and ran it around the picture moulding, connecting one end to the antenna binding post of my set, and letting the other hang loose. With this arrangement I could hear all the local stations very well. Experimenting further, I took an oatmeal box, and wrapped twenty-four turns of No. 18 DCC around it in one direction, and then reversing the direction wound twenty-four more. I connected this arrangement in series with the picture moulding antenna and aerial post in the receiver, using the regular ground.

With this arrangement I have been able to hear all local stations with great audibility, and have so far increased my range to WOC at Davenport, Iowa. All the local DX (within 100 miles) stations come very well. I am enclosing a sketch of the arrangement.

Very truly yours,

J. A. LELAND.

6408 Drexel Ave., Chicago, Ill.

Every little thing helps, Mr. Leland, so we thank you for the suggestion. Your suggestion is probably just what the fellows you mention are looking for. We might add, however, that the addition of one or two stages of radio frequency would probably increase the range to a remarkable degree. We are printing in Figures 2 and 3 a suitable arrangement, with Mr. Leland's picture-moulding-oatmeal-box antenna. Please notice Mr. Leland uses a Reinartz!

Well, fellows, this will be about all until next year, but before we quit we want to tell you to be sure and get your sets all set to tune in good and strong on station XMAS. S'long! C U in 1924.

.—.—. . . .—.—

Here's another record to shoot at, men! Fred Marco, secretary of the

(Continued on page 38.)

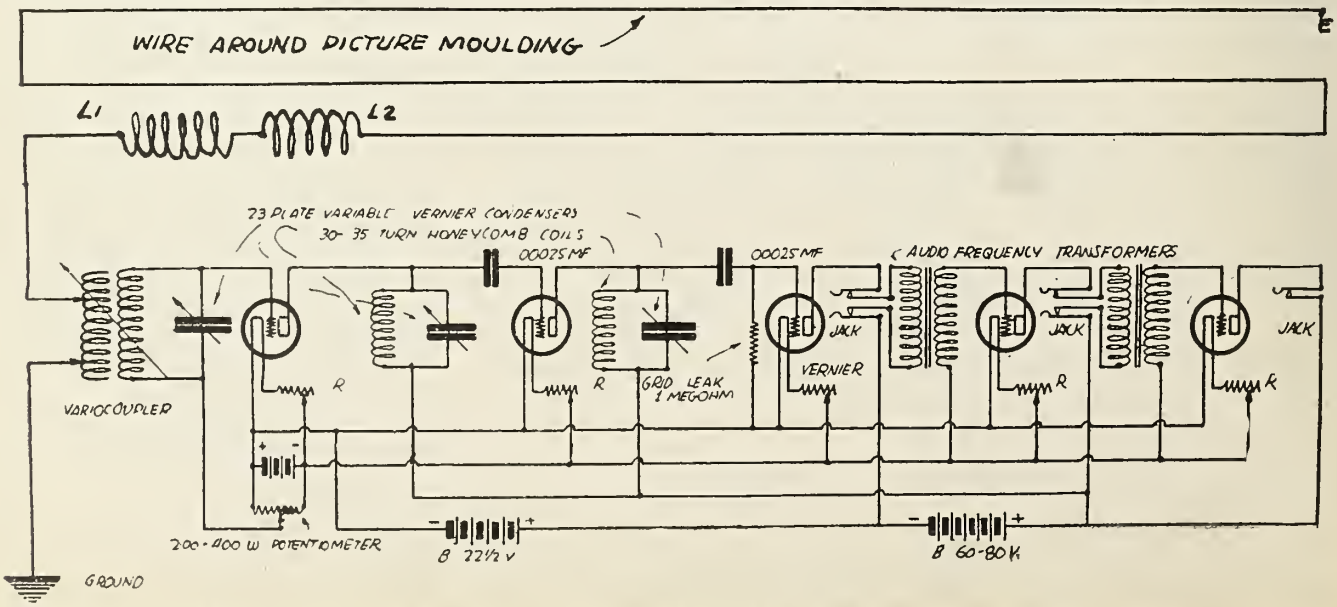


Figure 2. This composite sketch shows Mr. Leland's arrangement of using the picture moulding oatmeal box antenna. L1 is a coil wound on an oatmeal box, having 25 turns and L2 is a coil of the same number of turns, wound on the same box in the opposite direction from L1. The circuit shown, while not of the type used by Mr. Leland, is a type of circuit particularly adaptable to the experiment

Complete Corrected List of U. S. and Canadian Broadcasting Stations

Complete Each Issue

THE list of broadcasting stations on these pages is brought up to date each month by additions of new stations and deletion of those which have suspended operation. The list is the product of a vast volume of correspondence and its completeness is due in large measure to the assistance of our special news service in Washington, D. C. Suggestions, corrections and additional data will be welcomed from readers. Broadcasters: Send in your program schedules.

			Wave length
KDKA	Westinghouse Electric & Mfg. Co.	East Pittsburgh	326
KDPM	Westinghouse Electric & Mfg. Co.	Cleveland, Ohio	270
KDPT	Southern Electrical Co.	San Diego, Calif.	244
KDYL	Telegram Publishing Co.	Salt Lake City, Utah	360
KDYM	Savoy Theatre	San Diego, Calif.	252
KDYQ	Oregon Institute of Technology	Portland, Oreg.	360
KDYS	The Tribune	Great Falls, Mont.	360
KDYW	Smith Hughes & Co.	Phoenix, Ariz.	360
KDYX	Star Bulletin	Honolulu, Hawaii	360
KDZB	Frank E. Siefert	Bakersfield, Calif.	240
KDZE	The Rhodes Co.	Seattle, Wash.	455
KDZF	Automobile Club of Southern California	Los Angeles, Calif.	278
KDZI	Electric Supply Co.	Wenatchee, Wash.	360
KDZK	Nevada Machinery & Electric Co.	Reno, Nev.	360
KDZQ	Nichols Academy of Dancing	Denver, Colo.	360
KDZR	Bellingham Publishing Co.	Bellingham, Wash.	261
KDZT	Seattle Radio Assn.	Seattle, Wash.	360
KFAD	McArthur Bros. Mercantile Co.	Phoenix, Ariz.	360
KFAE	State College of Washington	Pullman, Wash.	360
KFAF	Western Radio Corp.	Denver, Colo.	360
KFAJ	University of Colorado	Boulder, Colo.	360
KFAN	The Electric Shop	Moscow, Idaho	360
KFAP	Standard Publishing Co.	Butte, Mont.	360
KFAR	Studio Lighting Service Co. (O. K. Olsen)	Hollywood, Calif.	280
KFAU	Independent School District of Boise City, Boise High School, Boise, Idaho		270
KFAV	Abbot Kinney Co.	Venice, Calif.	224
KFAW	The Radio Den (W. B. Ashford)	Santa Ana, Calif.	280
KFAY	W. J. Virgin	Medford, Oreg	283
KFBB	F. A. Buttrey & Co.	Havre, Mont.	360
KFBC	W. K. Azbill	San Diego, Calif.	278
KFBE	Reuben H. Horn	San Luis Obispo, Calif.	360
KFBG	First Presbyterian Church	Tacoma, Wash.	360
KFBK	Kimball-Upson Co.	Sacramento, Calif.	283
KFBL	Leese Bros.	Everett, Wash.	224
KFBS	Trinidad Gas & Electric Supply Co. and the Chronicle News	Trinidad, Colo.	360
KFBU	The Cathedral (Bishop N. S. Thomas)	Laramie, Wyo.	283
KFCB	Nielsen Radio Supply Co.	Phoenix, Ariz.	238
KFCD	Salem Electric Co. (F. S. Barton)	Salem, Oreg.	360
KFCF	Frank A. Moore	Walla Walla, Wash.	360
KFCH	Electric Service Station (Inc.)	Billings, Mont.	360
KFCK	Colorado Springs Radio Co.	Colorado Springs, Colo.	258
KFCL	Los Angeles Union Stock Yards	San Antonio, Calif.	360
KFCM	Richmond Radio Shop (Frank T. Doeing)	Richmond, Calif.	360
KFCP	Ralph W. Flygare	Ogden, Utah	360
KFCV	Fred Mahaffey, Jr.	Houston, Tex.	360
KFCY	Western Union College	LeMars, Iowa	252
KFCZ	Omaha Central High School	Omaha, Nebr.	258
KFDA	Adler's Music Store	Baker, Oreg.	360
KFDD	St. Michaels Cathedral	Boise, Idaho	252
KFDH	University of Arizona	Tucson, Ariz.	360
KFDJ	Oregon Agricultural College	Corvallis, Oreg.	360
KFDL	Knight-Campbell Music Co.	Denver, Colo.	360
KFDO	H. Everett Cutting	Bozeman, Mont.	248
KFDR	Bullock's Hardware & Sporting Goods (Robert G. Bullock). York, Nebr		360
KFDU	Nebraska Radio Electric Co.	Lincoln, Nebr.	240
KFDV	Gilbrech & Stinson	Fayetteville, Ark.	360
KFDX	First Baptist Church	Shreveport, La.	360
KFDY	South Dakota State College of Agriculture and Mechanic Arts,	Brookings, S. Dak.	360
KFDZ	Harry O. Iverson	Minneapolis, Minn.	360
KFEC	Meier & Frank Co.	Portland, Oreg.	360
KFEJ	Guy Greason	Tacoma, Wash.	360
KFEL	Winner Radio Corp.	Denver, Colo.	360
KFEP	Radio Equipment Co. (Joseph L. Turre)	Denver, Colo.	240
KFEQ	J. L. Scroggin	Oak, Nebr.	360
KFER	Auto Electric Service Co.	Fort Dodge, Iowa	231
KFEV	Radio Electric Shop	Douglas, Wyo.	263
KFEX	Augsburg Seminary	Minneapolis, Minn.	261
KFEY	Bunker Hill & Sullivan Mining & Concentrating Co.	Kellogg, Idaho	360
KFEZ	American Society of Mechanical Engineers (F. H. Schubert,)	St. Louis, Mo.	360
KFFA	Dr. R. O. Shelton	San Diego, Calif.	212
KFFB	Jenkins Furniture Co.	Boise, Idaho	240
KFFE	Eastern Oregon Radio Co.	Pendleton, Oreg.	360
KFFG	Dr. E. H. Smith	Hillsboro, Oreg.	229
KFFQ	Markshoffel Motor Co.	Colorado Springs, Colo.	360
KFFR	Nevada State Journal (Jim Kirk)	Sparks, Nev.	226
KFFV	Graceland College	Lamoni, Iowa	360
KFFX	McGraw Co.	Omaha, Nebr.	278
KFFY	Pincus & Murphy	Alexandria, La.	275
KFFZ	Al. G. Barnes Amusement Co.	Dallas, Tex. (portable)	226
KFGC	Louisiana State University	Baton Rouge, La.	254
KFGD	Chickasha Radio & Electric Co.	Chickasha, Okla.	248
KFGH	Leland Stanford University	Stanford University, Calif.	360
KFGJ	Missouri National Guard, 138th Infantry	St. Louis, Mo.	266
KFGL	Arlington Garage	Arlington, Oreg.	234
KFGQ	Crary Hardware Co.	Boone, Iowa	226
KFGV	Heidbreder Radio Supply Co.	Utica, Nebr.	224
KFGX	First Presbyterian Church	Orange, Tex.	250
KFGZ	Emmanuel Missionary College	Berrien Springs, Mich.	268
KFHA	Western State College of Colorado	Gunnison, Colo.	252
KFHB	Rialto Theater (P. L. Beardwell)	Hood River, Oreg.	280
KFHD	Utz Electric Shop Co.	St. Joseph, Mo.	226
KFHF	Central Christian Church	Shreveport, La.	266
KFHH	Ambrose A. McCue	Neah Bay, Wash.	283
KFHJ	Fallon & Co.	Santa Barbara, Calif.	360
KFHQ	Curtis Brothers Hardware Store (Alfred E. Fowler)	Los Gatos, Calif.	242
KFHR	Star Electric & Radio Co.	Seattle, Wash.	270
KFHS	Clifford J. Dow	Lihue, Hawaii	275
KFHU	M. G. Sateren	Mayville, N. Dak.	261
KFHX	Robert W. Nelson	Hutchinson, Kans.	229
KFI	Earle C. Anthony (Inc.)	Los Angeles, Calif.	469
KFIB	Franklin W. Jenkins	St. Louis, Mo.	244
KFID	Ross Arbuckle's Garage	Jola, Kans.	246
KFIF	Benson Polytechnic Institute	Portland, Oreg.	360
KFIK	Gladbrook Electrical Co.	Gladbrook, Iowa	234
KFIL	Windisch Electric Farm Equipment Co.	Louishurg, Kans.	234
KFIO	North Central High School	Spokane, Wash.	252
KFIQ	Yakima Valley Radio Broadcasting Association	Yakima, Wash.	224
KFIU	Alaska Electric Light & Power Co.	Juneau, Alaska	226
KFIV	V. H. Broyles	Pittsburg, Kans.	240
KFIX	Reorganized Church of Jesus Christ of Latter Day Saints	Independence, Mo.	240
KFIY	Brott Laboratories	Seattle, Wash.	236
KFIZ	Daily Commonwealth and Oscar A. Huelsman	Fond du Lac, Wis.	273
KFJA	Central Power Co.	Grand Island, Nebr	244
KFJB	Marshall Electrical Co.	Marshalltown, Iowa	248
KFJC	Seattle Post Intelligencer	Seattle, Wash.	233
KFJD	Weld County Printing & Publishing Co.	Greeley, Colo.	236
KFJF	National Radio Manufacturing Co.	Oklahoma City, Okla.	252
KFJH	"The Sugar Bowl" (H. R. Shaw)	Selma, Calif.	273
KFJI	Liberty Theatre (E. E. Marsh)	Astoria, Oreg.	252
KFJJ	Carrollton Radio Shop	Carrollton, Mo.	236
KFJK	Delano Radio and Electric Co.	Bristow, Okla.	233
KFJL	Hardsacg Manufacturing Co.	Ottumwa, Iowa	242
KFJM	University of North Dakota	Grand Forks, N. Dak.	229
KFJR	Ashley C. Dixon & Son	Stevensville, Mont. (near)	258
KFJU	Central Power Co.	Kearney, Nebr.	234
KFJV	Thomas H. Warren	Dexter, Iowa	224
KFJW	Le Grand Radio Co.	Towanda, Kans.	226
KFJX	Iowa State Teachers' College	Cedar Falls, Iowa	229
KFJY	Tunwall Radio Co.	Fort Dodge, Iowa	246
KFJZ	Texas National Guard, One hundred and twelfth Cavalry Fort Worth, Tex.		254
KFKA	Colorado State Teachers College	Greeley, Colo.	248
KFKB	Brinkley-Jones Hospital Association	Milford, Kans.	286
KFKH	Denver Park & Amusement Co.	Lakeside, Colo.	226
KFKQ	Conway Radio Laboratories (Ben H. Woodruff)	Conway, Ark.	224
KFKV	F. F. Gray	Butte, Mont.	283
KFKX	Westinghouse Electric & Manufacturing Co.	Hastings, Nebr.	286
KFKZ	Nassour Bros. Radio Co.	Colorado Springs, Colo.	234
KFLA	Abner R. Willson	Butte, Mont	283
KFLB	Signal Electric Manufacturing Co.	Menominee, Mich.	248
KFLD	Paul E. Greenlaw	Franklinton, La.	234
KFLE	National Educational Service	Denver, Colo.	268
KFLH	Erickson Radio Co.	Salt Lake City, Utah	261
KFLP	Everette M. Foster	Cedar Rapids, Iowa	240
KFLQ	Bizzell Radio Shop	Little Rock, Ark.	261
KFLR	University of New Mexico	Albuquerque, N. Mex.	254
KFLU	Rio Grande Radio Supply House	San Benito, Texas	236
KFLV	Rev. A. T. Frykman	Rockford, Ill.	229
KFLW	Missoula Electric Supply Co.	Missoula, Mont.	234
KGB	Tacoma Daily Ledger	Tacoma, Wash.	252
KGG	Hallock & Watson Radio Service	Portland, Oreg.	360
KGN	Northwestern Radio Mfg. Co.	Portland, Oreg.	360
KGU	Marion A. Mulrony	Honolulu, Hawaii, Waikiki Beach.	360
KGW	Portland Morning Oregonian	Portland, Oreg.	492
KGY	St. Martins College (Rev. Sebastian Ruth),	Lacy Wash.	258
KHJ	Times-Mirror Co.	Los Angeles, Calif.	395
KHQ	Louis Wasmer	Seattle, Wash.	360
KJQ	C. O. Gould	Stockton, Calif.	360
KJR	Northwest Radio Service Co.	Seattle, Wash.	270
KJS	Bible Institute of Los Angeles	Los Angeles, Calif.	360
KLN	Monterey Electric Shop	Monterey, Calif.	261
KLS	Warner Brothers Radio Supplies Co.	Oakland, Calif.	360
KLX	Tribune Publishing Co.	Oakland, Calif.	360
KLZ	Reynolds Radio Co.	Denver, Colo.	360
KMJ	San Joaquin Light & Power Corp.	Fresno, Calif.	273
KMO	Love Electric Co.	Tacoma, Wash.	360
KNJ	Roswell Public Service Co.	Roswell, N. Mex.	250
KNT	Grays Harbor Radio Co. (Walter Hemrich)	Aberdeen, Wash.	263
KNV	Radio Supply Co.	Los Angeles, Calif.	256
KNX	Electric Lighting Supply Co.	Los Angeles, Calif.	360
KOB	New Mexico College of Agriculture & Mechanic Arts	State College, N. Mex.	360
KOP	Detroit Police Department	Detroit, Mich.	286
KPO	Hale Bros.	San Francisco, Calif.	423
KQI	University of California	Berkeley, Calif.	360
KQP	Apple City Radio Club	Hood River, Oreg.	360
KQV	Doubleday-Hill Electric Co.	Pittsburgh, Pa.	360
KQW	Charles D. Herrold	San Jose, Calif.	360
KRE	Berkeley Daily Gazette	Berkeley, Calif.	278
KSD	Post Dispatch (Pulitzer Pub. Co.)	St. Louis, Mo.	546
KSS	Prest & Dean Radio Co. and Radio Research Society of Long Beach,	Calif.	360
KTW	First Presbyterian Church	Seattle, Wash.	360
KUO	Examiner Printing Co.	San Francisco, Calif.	360
KUS	City Dye Works & Laundry Co.	Los Angeles, Calif.	360
KUY	Coast Radio Co.	El Monte, Calif.	256
KWG	Portable Wireless Telephone Co.	Stockton, Calif.	360
KWH	Los Angeles Examiner	Los Angeles, Calif.	360
KXD	Modesto Herald Publishing Co.	Modesto, Calif.	252
KYQ	Electric Shop	Honolulu, Hawaii	360
KYW	Westinghouse Electric & Mfg. Co.	Chicago, Ill.	536
KZM	Preston D. Allen	Oakland, Calif.	360
KZN	The Deseret News	Salt Lake City, Utah	360
KZV	Wenatchee Battery & Motor Co.	Wenatchee, Wash.	360
WAAB	Valdemar Jensen	New Orleans, La.	268
WAAC	Tulane University	New Orleans, La.	360
WAAD	Ohio Mechanics Institute	Cincinnati, Ohio	360
WAAF	Chicago Daily Drovers Journal	Chicago, Ill.	286
WAAK	Gimbel Brothers	Milwaukee, Wis.	280
WAAM	I. R. Nelson Co.	Newark, N. J.	263
WAAN	University of Missouri	Columbia, Mo.	254
WAAW	Omaha Grain Exchange	Omaha, Nebr.	360
WAAZ	Hollister-Miller Motor Co.	Emporia, Kans.	360
WABA	Lake Forest College	Lake Forest, Ill.	266
WABB	Dr. John B. Lawrence	Harrisburg, Pa.	266
WABC	Fulwider-Grimes Battery Co.	Anderson, Ind.	229
WABD	Parker High School	Dayton, Ohio	283
WABE	Young Men's Christian Association	Washington, D. C.	283
WABF	Mount Vernon Register-News Co.	Mount Vernon, Ill.	234
WABG	Arnold Edwards Piano Co.	Jacksonville, Fla.	248
WABH	Lake Shore Tire Co.	Sandusky, Ohio	240
WABI	Bangor Railway & Electric Co.	Bangor, Me.	240
WABJ	The Radio Laboratories	South Bend, Ind.	240
WABK	First Baptist Church	Worcester, Mass.	252
WABL	Connecticut Agricultural College	Storrs, Conn.	283
WABM	F. E. Doherty Automotive and Radio Equipment Co.	Saginaw, Mich.	254
WABO	Waldo C. Grover	La Crosse, Wis.	244
WABQ	Lake Avenue Baptist Church	Rochester, N. Y.	252
WABP	Robert F. Wehnig	Dover, Ohio	266
WBAA	Purdue University	West Layayette, Ind.	360
WBAD	Sterling Electric Co.	Minneapolis, Minn.	360
WBAH	The Dayton Co.	Minneapolis, Minn.	417
WBAN	Wireless Phone Corp.	Paterson, N. J.	244
WBAO	James Millikin University	Decatur, Ill.	360
WBAP	Wortham-Carter Publishing Co. (Star Telegram)	Fort Worth, Tex.	476
WBAV	Erner & Hopkins Co.	Columbus, Ohio	390

Complete Corrected List of U. S. and Canadian Broadcasting Stations

WBAW	Marietta College	Marietta, Ohio	246
WBAX	John H. Stenger, Jr.	Wilkes-Barre, Pa.	360
WBAY	Western Electric Co.	New York, N. Y.	492
WBBA	Newark Radio Laboratories	Newark, Ohio	240
WBBD	Barbey Battery Service	Reading, Pa.	234
WBL	T & H Radio Co.	Anthony, Kans.	261
WBS	D. W. May, Inc	Newark, N. J.	360
WRT	Southern Radio Corp.	Charlotte, N. C.	360
WBZ	Westinghouse Elec. & Mfg. Co.	Springfield, Mass.	337
WCAD	St. Lawrence University	Canton, N. Y.	280
WCAE	Kaufmann & Baer Co.	Pittsburgh, Pa.	462
WCAG	Clyde R. Randall	New Orleans, La.	268
WCAH	Entrekin Electric Co.	Columbus, Ohio	286
WCAJ	Nebraska Wesleyan University	University Place, Nebr.	360
WCAK	Alfred P. Daniel	Houston, Tex.	360
WCAL	St. Olaf College	Northfield, Minn.	360
WCAM	Villanova College	Villanova, Pa.	360
WCAD	Sanders & Stayman Co.	Baltimore, Md.	360
WCAP	Chesapeake & Potomac Telephone Co.	Washington, D. C.	469
WCAR	Alamo Radio Electric Co.	San Antonio, Tex.	360
WCAS	William Hood Dunwoody Industrial Institute	Minneapolis, Minn.	246
WCAT	South Dakota State School of Mines	Rapid City, S. Dak.	240
WCAU	Durham & Co.	Philadelphia, Pa.	286
WCAV	J. C. Dice Electric Co.	Little Rock, Ark.	360
WCAX	University of Vermont	Burlington, Vt.	360
WCAY	Kesselman O'Driscoll Co.	Milwaukee, Wis.	261
WCAZ	Carthage College	Carthage, Ill.	246
WCBA	Charles W. Heimbach	Allentown, Pa.	280
WCBB	K. & K. Radio Supply Co. (Charles H. Katzenberger)	Greenville, Ohio	240
WCBD	Wilbur G. Voliva	Zion, Ill.	345
WCE	Findley Electric Co.	Minneapolis, Minn.	360
WCK	Stix, Baer & Fuller Dry Goods Co.	St. Louis, Mo.	360
WCM	University of Texas	Austin, Tex.	360
WCX	Detroit Free Press	Detroit, Mich.	517
WDAE	Tampa Daily Times	Tampa, Fla.	360
WDAF	Kansas City Star	Kansas City, Mo.	411
WDAG	J. Laurance Martin	Amarillo, Tex.	263
WDAH	Trinity Methodist Church (South)	El Paso, Tex.	268
WDAI	Hughes Radio Corp.	Syracuse, N. Y.	246
WDAK	The Courant	Hartford, Conn.	261
WDAL	Florida Times-Union	Jacksonville, Fla.	360
WDAD	Automotive Electric Co.	Dallas, Tex.	360
WDAP	Board of Trade	Chicago, Ill.	360
WDAR	Lit Brothers	Philadelphia, Pa.	395
WDAS	Samuel A. Waite	Worcester, Mass.	360
WDAU	Slocum Kilburn	New Bedford, Mass.	360
WDAX	First National Bank (Appamoose County Farm Bureau)	Centerville, Iowa	360
WDAY	Radio Equipment Corp.	Fargo, N. Dak.	244
WDBC	Kirk, Johnson & Co.	Lancaster, Pa.	258
WDBF	Robert G. Phillips	Youngstown, Ohio	261
WDM	Church of the Convenant	Washington, D. C.	360
WDT	Ship Owners Radio Service	New York, N. Y.	405
WDZ	James L. Bush	Tuscola, Ill., Star Store Bldg.	278
WEAA	F. D. Fallain	Flint, Mich.	280
WEAF	American Telephone & Telegraph Co.	New York, N. Y.	492
WEAH	Wichita Board of Trade	Wichita, Kans.	244
WEAI	Cornell University	Ithaca, N. Y.	286
WEAJ	University of South Dakota	Vermillion, S. Dak.	283
WEAM	Borough of North Plainfield (W. Gibson Buttfield)	North Plainfield, N. J.	252
WEAN	Shepard Co.	Providence, R. I.	273
WEAD	Ohio State University	Columbus, Ohio	360
WEAP	Mobile Radio Co.	Mobile, Ala.	360
WEAR	Baltimore American & News Publishing Co.	Baltimore, Md.	360
WEAS	Hecht Co.	Washington, D. C.	360
WEAU	Davidson Bros. Co.	Sioux City, Iowa	360
WEAY	Iris Theatre (Will Horowitz, Jr.)	Houston, Tex.	360
WEB	Benwood Co.	St. Louis, Mo.	360
WEV	Hurlhurt-Still Electrical Co.	Houston, Tex.	360
WEW	St. Louis University	St. Louis, Mo.	261
WFAA	Dallas News & Dallas Journal	Dallas, Tex.	476
WFAB	Carl F. Woese	Syracuse, N. Y.	234
WFAF	H. C. Spratley Radio Co.	Pouchkeepsie, N. Y.	360
WFAH	Electric Supply Co.	Port Arthur, Tex.	236
WFAJ	Hi-Grade Wireless Instrument Co.	Asheville, N. C.	360
WFAM	Times Publishing Co.	St. Cloud, Minn.	360
WFAN	Hutchinson Electric Service Co.	Hutchinson, Minn.	360
WFAQ	Missouri Wesleyan College	Cameron, Mo.	360
WFAT	Daily Argus-Leader	Sioux Falls, S. Dak.	360
WFAV	University of Nebraska, Department of Electrical Engineering	Lincoln, Nebr.	275
WFI	Strawbridge & Clothier	Philadelphia, Pa.	395
WGAL	Lancaster Electric Supply & Construction Co.	Lancaster, Pa.	248
WGAN	Cecil E. Lloyd	Pensacola, Fla.	360
WGAQ	Glenwood Radio Corp. (W. G. Patterson)	Shreveport, La.	360
WGAR	Southwest American	Fort Smith, Ark.	360
WGAU	Radio Manufacturing & Service Co (Marcus G. Limb)	Wooster, Ohio	226
WGAW	Ernest C. Albright	Altoona, Pa.	261
WGAY	Northwestern Radio Co.	Madison, Wis.	360
WGAZ	South Bend Tribune	South Bend, Ind.	360
WGI	American Radio & Research Corp.	Medford Hillside, Mass.	360
WGL	Thomas F. J. Howlett	Philadelphia, Pa.	360
WGR	Federal Telephone & Telegraph Co.	Buffalo, N. Y.	319
WGV	Interstate Electric Co.	New Orleans, La.	360
WGY	General Electric Co.	Schenectady, N. Y.	380
WHA	University of Wisconsin	Madison, Wis.	360
WHAA	State University of Iowa	Iowa City, Iowa	283
WHAB	Clark W. Thompson	Galveston, Tex.	360
WHAC	Cole Bros. Electric Co.	Waterloo, Iowa	360
WHAD	Marquette University	Milwaukee, Wis.	280
WHAG	University of Cincinnati	Cincinnati, Ohio	222
WHAH	Hafer Supply Co.	Joplin, Mo.	360
WHAI	Radio Equipment & Mfg. Co.	Davenport, Iowa	360
WHAK	Roberts Hardware Co.	Clarksburg, W. Va.	258
WHAL	Lansing Capital News	Lansing, Mich.	248
WHAM	University of Rochester (Eastman School of Music)	Rochester, N. Y.	283
WHAP	Otta & Kuhns	Decatur, Ill.	360
WHAQ	Semmes Motor Co.	Washington, D. C.	360
WHAR	Paramount Radio & Electric Co. (W. H. A. Pulus)	Atlantic City, N. J.	231
WHAS	Courier-Journal & Louisville Times	Louisville, Ky.	400
WHAV	Wilmington Electrical Specialty Co.	Wilmington, Del.	360
WHAZ	Rensselaer Polytechnic Institute	Troy, N. Y.	380
WHB	Sweeney School Co.	Kansas City, Mo.	411
WHD	West Virginia University	Morgantown, W. Va.	360
WHK	Radiovox Co (Warren R. Cox)	Cleveland, Ohio	360
WHN	George Schubel	New York, N. Y.	360
WIAB	Joslyn Automobile Co.	Rockford, Ill.	252
WIAC	Galveston Tribune	Galveston, Tex.	360
WIAD	Howard R. Miller	Ocean City, N. J.	254
WIAF	Gustav A. DeCortin	New Orleans, La.	234
WIAH	Continental Radio & Mfg. Co.	Newton, Iowa	258
WIAI	Heer Stores Co.	Springfield, Mo.	252
WIAI	Fox River Valley Radio Supply Co. (Quinn Bros.)	Neenah, Wis.	224
WIAK	Journal-Stockman Co.	Omaha, Nebr.	278
WIAO	School of Engineering of Milwaukee	Milwaukee, Wis.	360
WIAQ	Chronicle Publishing Co.	Marion, Ind.	226
WIAR	Paducah Evening Sun	Paducah, Ky.	360
WIAS	Home Electric Co.	Burlington, Iowa	360
WIAT	Leon T. Noel	Tarklo, Mo.	360
WIAU	American Trust & Savinga Bank	Le Mars, Iowa	360
WIK	K. & L. Electric Co. (Herbert F. Kelso and Hunter J. Lohman)	McKeesport, Pa.	234
WIL	Continental Electric Supply Co.	Washington, D. C.	360
WIP	Gimbel Brothers	Philadelphia, Pa.	509
WJAB	American Electric Co.	Lincoln, Nebr.	360
WJAD	Jackson'a Radio Engineering Laboratories	Waco, Tex.	360
WJAF	Press Publishing Co.	Muncie, Ind.	360
WJAG	Norfolk Daily News (Huse Pub. Co.)	Norfolk, Nebr.	360
WJAK	Clifford L. White	Greentown, Ind.	254
WJAM	D. M. Perham	Cedar Rapids, Iowa	268
WJAN	Peoria Star	Peoria, Ill.	280
WJAQ	Capper Publications	Topeka, Kans.	360
WJAR	The Outlet Co. (J. Samuels & Bro.)	Providence, R. I.	360
WJAS	Pittsburgh Radio Supply House	Pittsburgh, Pa.	360
WJAT	Kelly-Vawter Jewelry Co.	Marshall, Mo.	360
WJAX	Union Trust Co.	Cleveland, Ohio	390
WJAZ	Chicago Radio Laboratory	Chicago, Ill.	448
WJD	Richard H. Howe	Granville, Ohio	229
WJH	W. P. Boyer	Washington, D. C.	273
WJX	Deforest Radio Telephone & Telegraph Co.	New York, N. Y.	360
WJY	R. C. A.	New York, N. Y.	405
WJZ	R. C. A.	New York, N. Y.	455
WKAA	H. F. Paar	Cedar Rapids, Iowa	268
WKAD	Chas. Looff (Crescent Park)	East Providence, R. I.	240
WKAF	W. S. Radio Supply Co.	Wichita Falls, Tex.	360
WKAN	United Battery Service Co.	Montgomery, Ala.	226
WKAP	Dutee W. Flint	Cranston, R. I.	360
WKAQ	Radio Corp. of Porto Rico	San Juan, P. R.	360
WKAR	Michigan Agriculture College	East Lansing, Mich.	280
WKAS	L. E. Lines Music Co.	Springfield, Mo.	360
WKAV	Laconia Radio Club	Laconia, N. H.	254
WKAW	Turner Cycle Co.	Beloit, Wis.	242
WKAY	Brenau College	Gainesville, Ga.	280
WKC	Joseph M. Zamoiski Co.	Baltimore, Md.	360
WKY	WKY Radio Shop	Oklahoma, Okla.	360
WLAG	Cutting & Washington Radio Corp.	Minneapolis, Minn.	417
WLAH	Samuel Woodworth	Syracuse, N. Y.	234
WLAJ	Waco Electrical Supply Co.	Waco, Tex.	360
WLAK	Vermont Farm Machine Corp.	Bellows Falls, Vt.	360
WLAL	Naylor Electrical Co.	Tusla, Okla.	360
WLAN	Putnam Hardware Co.	Houlton, Me.	283
WLAP	W. V. Jordon	Louisville, Ky.	360
WLAQ	Arthur E. Schilling	Kalamazoo, Mich.	360
WLAT	Radio and Specialty Co.	Burlington, Iowa	360
WLAV	Electric Shop	Pensacola, Fla.	254
WLAW	Police Dept., City of New York	New York, N. Y.	360
WLAX	Putnam Electric Co. (Greencastle Community Broadcasting Station)	Greencastle, Ind.	231
WLB	University of Minnesota	Minneapolis, Minn.	360
WLW	Crosley Manufacturing Co.	Cincinnati, Ohio	309
WMAB	Radio Supply Co.	Oklahoma, Okla.	360
WMAC	J. Edw. Page (Olive B. Meredith)	Cazenovia, N. Y.	261
WMAF	Round Hills Radio Corp.	Dartmouth, Mass.	360
WMAH	General Supply Co.	Lincoln, Nebr.	254
WMAJ	Drovers Telegram Co.	Kansas City, Mo.	275
WMAK	Norton Laboratories	Lockport, N. Y.	360
WMAL	Trenton Hardware Co.	Trenton, N. J.	256
WMAN	First Baptist Church	Columbus, Ohio	286
WMAP	Utility Battery Service	Easton, Pa.	246
WMAQ	Chicago Daily News	Chicago, Ill.	448
WMAV	Alabama Polytechnic Institute	Auburn, Ala.	250
WMAY	Kingshighway Presbyterian Church	St. Louis, Mo.	280
WMAZ	Mercer University	Macon, Ga.	268
WMC	"Commercial Appeal" (Commercial Publishing Co.)	Memphis, Tenn.	500
WMH	Precision Equipment Co.	Cincinnati, Ohio	248
WMU	Doubleday-Hill Electric Co.	Washington, D. C.	261
WNAC	Shepard Stores	Boston, Mass.	278
WNAD	University of Oklahoma	Norman, Okla.	360
WNAL	R. J. Rockwell	Omaha, Nebr.	242
WNAM	Ideal Apparatus Co.	Evansville, Ind.	360
WNAN	Syracuse Radio Telephone Co.	Syracuse, N. Y.	286
WNAP	Wittenberg College	Springfield, Ohio	231
WNAQ	Charleston Radio Electric Co.	Charleston, S. C.	360
WNAR	C. C. Rhodes	Butler, Mo.	231
WNAS	Texas Radio Corp. & Austin Statesman	Austin, Tex.	360
WNAT	Lennig Brothers Co. (Frederick Lennig)	Philadelphia, Pa.	360
WNAV	Peoples Telephone & Telegraph Co.	Knoxville, Tenn.	236
WNAW	Peninsular Radio Club (Henry Kunzmann)	Fort Monroe, Va.	360
WNAX	Dakota Radio Apparatus Co.	Yankton, S. Dak.	244
WNJ	Shotton Radio Manufacturing Co.	Albany, N. Y.	360
WDAA	Dr. Walter Hardy	Ardmore, Okla.	360
WDAC	Mans Radio Co.	Lima, Ohio	266
WDAD	Friday Battery & Electric Corp.	Sigourney, Iowa	360
WDAE	Midland College	Fremont, Nebr.	360
WDAF	Tyler Commercial College	Tyler, Tex.	360
WOAG	Apollo Theater (Belvidere Amusement Co.)	Belvidere, Ill.	224
WOAH	Palmetto Radio Corp.	Charleston, S. C.	360
WDAI	Southern Equipment Co.	San Antonio, Tex.	385
WDAJ	Ervins Electrical Co.	Parsons, Kans.	258
WOAL	William E. Woods	Webster Groves, Mo.	229
WDAN	Vaughn Conservatory of Music (James D. Vaughn)	Lawrenceburg, Tenn.	360
WDAD	Lyradion Mfg. Co.	Mishawaka, Ind.	360
WDAP	Kalamazoo College	Kalamazoo, Mich.	240
WOAQ	Portsmouth Kiwanis Club	Portamouth, Va.	360
WDAT	Boyd M. Hamp	Wilmington, Del.	360
WDAV	Pennsylvania National Guard, 2d Battallon, 112th Infantry	Erie, Pa.	242
WDAW	Woodmen of the World	Omaha, Nebr.	526
WOAX	Franklyn J. Wolff	Trenton, N. J.	240
WOAZ	Penick Hughes Co.	Stamford, Tex.	360
WOC	Palmer School of Chiropractic	Davenport, Iowa	484
WDI	Iowa State College	Amea, Iowa	360
WOK	Pine Bluff Co.	Pine Bluff, Ark.	360
WOO	John Wanamaker	Philadelphia, Pa.	509
WOQ	Western Radio Co.	Kansas City, Mo.	360
WOR	L. Bamberger & Co.	Newark, N. J.	405
WOS	Missouri State Marketing Bureau	Jefferson City, Mo.	441
WPAB	Pennsylvania State College	State College, Pa.	360
WPAC	Donaldson Radio Co.	Okmulgee, Okla.	360
WPAD	W. A. Wiebodt & Co.	Chicago, Ill.	360
WPAH	Wisconsin Department of Markets	Waupaca, Wis.	360
WPAI	Doolittle Radio Corp.	New Haven, Conn.	268
WPAK	North Dakota Agricultural College	Agricultural College, N. Dak.	360
WPAL	Superior Radio & Telep. Equipment Co.	Columbus, Ohio	286
WPAM	Auerbach & Guettel	Topeka, Kans.	360
WPAP	Theodore D. Phillips	Wincheater, Ky.	360
WPAQ	General Sales & Engineering Co.	Frostburg, Md.	360
WPAR	Ward Battery & Radio Co.	Beloit, Kans.	360
WPAT	St. Patricks Cathedral	El Paso, Tex.	360
WPAU	Concordia College	Moorhead, Minn.	360
WPAZ	John R. Koch (Dr.)	Charleston, W. Va.	273
WPG	Nusawg Poultry Farm	New Lebanon, Ohio	234
WQAA	Horace A. Beale, jr.	Parkersburg, Pa.	360
WQAC	E. B. Gish	Amarillo, Tex.	360
WQAD	Whitall Electric Co.	Waterbury, Conn.	242

Complete Corrected List of U. S. and Canadian Broadcasting Stations

WQAE	Moore Radio News Station (Edmund B. Moore)	Springfield, Vt.	275
WQAF	Sandusky Register	Sandusky, Ohio	240
WQAH	Brock-Anderson Electrical Engineering Co.	Lexington, Ky.	254
WQAL	Coles County Telep. and Teleg. Co.	Mattoon, Ill.	258
WQAM	Electrical Equipment Co.	Miami, Fla.	360
WQAN	Scranton Times	Scranton, Pa.	280
WQAO	Calvary Baptist Church	New York, N. Y.	360
WQAQ	Abilene Daily Reporter (West Texas Radio Co.)	Abilene, Tex.	360
WQAS	Prince-Walter Co.	Lowell, Mass.	266
WQAV	Huntington & Guerry (Inc.)	Greenville, S. C.	258
WQAW	Catholic University	Washington, D. C.	236
WQAX	Radio Equipment Co.	Peoria, Ill.	360
WRAA	Rice Institute	Houston, Tex.	360
WRAD	Taylor Radio Shop (G. L. Taylor)	Marion, Kans.	248
WRAF	The Radio Club (Inc)	Laporte, Ind.	224
WRAH	Stanley N. Read	Providence, R. I.	231
WRAL	Northern States Power Co.	St. Croix Falls, Wis.	248
WRAM	Lombard College	Galesburg, Ill.	244
WRAN	Black Hawk Electrical Co.	Waterloo, Iowa	236
WRAO	Radio Service Co.	St. Louis, Mo.	360
WRAU	Amarillo Daily News	Amarillo, Tex.	360
WRAV	Antioch College	Yellow Springs, Ohio	360
WRAW	Avenue Radio Shop (Horace D. Good)	Reading, Pa.	238
WRAX	Flaxon's Garage	Gloucester City, N. J.	268
WRAY	Radio Sales Corp.	Scranton, Pa.	280
WRAZ	Radio Shop of Newark (Herman Lubinsky)	Newark, N. J.	233
WRC	Radio Corporation of America	Washington, D. C.	469
WRK	Doron Bros. Electric Co.	Hamilton, Ohio	360
WRL	Union College	Schenectady, N. Y.	360
WRM	University of Illinois	Urbana, Ill.	360
WRR	City of Dallas (police and fire signal department)	Dallas, Tex.	360
WRW	Tarrytown Radio Research Laboratory (Koenig Bros.)	Tarrytown, N. Y.	273
WSAB	Southeast Missouri State Teachers College	Cape Girardeau, Mo.	360
WSAC	Clemson Agricultural College	Clemson College, S. C.	360
WSAD	J. A. Foster Co.	Providence, R. I.	261
WSAG	City of St. Petersburg (Loren V. Davis)	St. Petersburg, Fla.	244
WSAH	A. J. Leonard, jr.	Chicago, Ill.	248
WSAI	United States Playing Cards Co.	Cincinnati, Ohio	309
WSAJ	Grove City College	Grove City, Pa.	360
WSAK	Foster Egner (Daily News, Pomeroy, Ohio)	Middleport, Ohio	258
WSAL	Franklin Electric Co.	Brookville, Ind.	246
WSAN	Allentown Radio Club	Allentown, Pa.	229
WSAP	Seventh Day Adventist Church	New York, N. Y.	360
WSAR	Doughty & Welch Electrical Co.	Fall River, Mass.	254
WSAT	Donohoo-Ware Hardware Co.	Plainview, Tex.	268
WSAW	John J. Long, jr.	Canandaigua, N Y.	275
WSAX	Chicago Radio Laboratory	Chicago, Ill.	268
WSAY	Irving Austin (Port Chester Chamber of Commerce)	Port Chester, N. Y.	233
WSAZ	Chas Electric Shop	Pomeroy, Ohio	258
WSB	Atlanta Journal	Atlanta, Ga.	429
WSL	J. & M. Electric Co.	Utica, N. Y.	273
WSY	Alabama Power Co.	Birmingham, Ala.	360
WTAB	Fall River Daily Herald Publishing Co.	Fall River, Mass.	248
WTAC	Penn Traffic Co.	Johnstown, Pa.	360
WTAD	Robert E. Compton and First Presbyterian Church	Carthage, Ill.	229
WTAF	Louis J. Gallo	New Orleans, La.	242
WTAG	Kern Music Co.	Providence, R. I.	258
WTAH	Carmen Ferro	Belvidere, Ill.	236
WTAJ	The Radio Shop	Portland, Me.	236
WTAL	Toledo Radio & Electric Co.	Toledo, Ohio	252
WTAM	Willard Storage Battery Co.	Cleveland, Ohio	390
WTAN	Orndorff Radio Shop	Mattoon, Ill.	240
WTAP	Cambridge Radio & Electric Co.	Cambridge, Ill.	242
WTAQ	S. H. Van Gorden & Son	Osseo, Wis.	226
WTAR	Reliance Electric Co.	Norfolk, Va.	280
WTAS	Charles E. Erbstein	Elgin, Ill.	275
WTAT	Edison Electric Illuminating Co.	Boston, Mass. (portable)	244
WTAU	Ruegg - Battery & Electric Co.	Tecumseh, Nebr.	360
WTAW	Agricultural & Mechanical College of Texas	College Station, Tex.	280
WTAX	Williams Hardware Co.	Streator, Ill.	231
WTAY	Iodar-Oak Leaves Broadcasting Station	Oak Park, Ill.	226
WTAZ	Thomas J. McGuire	Lambertville, N. J.	283
WTG	Kansas State Agricultural College	Manhattan, Kans.	485
WWAB	Hoenig, Swern & Co. (John Rasmussen)	Trenton, N. J.	226
WWAC	Sanger Bros.	Waco, Tex.	360
WWAD	Wright & Wright (Inc.)	Philadelphia, Pa.	360
WWAE	Alamo Dance Hall, L. J. Crowley	Joliet, Ill.	227
WWAF	Galvin Radio Supply Co.	Camden, N. J.	236
WWAX	Wormer Bros.	Laredo, Tex.	360
WWB	Daily News Printing Co.	Canton, Ohio	268
WWI	Ford Motor Co.	Dearborn, Mich.	273
WWJ	Detroit News (Evening News Assn.)	Detroit, Mich.	517
WWL	Loyola University	New Orleans, La.	280

Canadian Stations

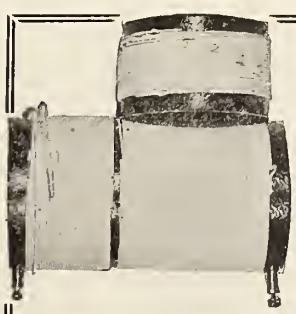
CFAC,	Calgary, Alta., Can. Western Radio Co., Ltd.
CFCA,	Toronto, Ont., Can. Toronto Star.
CFCB,	Vancouver, B. C., Can. Marconi Co.
CFCE,	Halifax, N. S., Can. Marconi Co.
CFCF,	Montreal, P. Q., Can, Marconi Co.
CFCH,	Iroquois Falls, Ont., Can. Abitibi Power & Paper Co., Ltd.
CFCI,	Walkerville, Ont., Can. Motor Products Corp.
CFCN,	Calgary, Alta., Can. W. W. Grant Radio, Ltd.
CFCX,	London, Ont., Can. The London Advertiser.
CFPC,	Fort Frances, Ont., Can. International Radio Develop. Co.
CFTC,	Toronto, Ont., Can. The Bell Telephone Co.
CFYC,	Vancouver, B. C., Can. Victor Wentworth Odlum.
CFZC,	Montreal, Que., Can. Can. Westinghouse Co., Ltd.
CHBC,	Calgary, Canada. W. W. Grant Radio, Ltd. (Morning Alberta.)
CHCA,	Vancouver, B. C., Can. Radio Corp. of Vancouver, Ltd.
CHCB,	Toronto, Can. Marconi Co.
CHCC,	Edmonton, Atia., Can. Can. Westinghouse Co., Ltd.
CHCF,	Winnipeg, Man., Can. Radio Corp. of Winnipeg, Ltd.
CHCQ,	Calgary, Alta., Can. Western Radio Co., Ltd.
CHCS,	London, Ont., Can. London Radio Shoppe.
CHCX,	Montreal, Que., Can. B. L. Silver.
CHCZ,	Toronto, Ont., Can. Globe Printing Co.
CHCO,	Vancouver, B. C., Can. Can. Westinghouse Co., Ltd.
CHVC,	Toronto, Can. Metropolitan Motors Co.
CHXC,	Ottawa, Ont., Can. J. B. Booth, Jr.
CHYC,	Montreal, Que., Can. Northern Elec. Co.
CJBC,	Montreal, Que., Can. Dupuis-Freres.
CJCA,	Edmonton, Alta., Can. Edmonton Journal, Ltd.
CJCB,	Nelson, B. C., Can. James Gordon Bennett.
CJCD,	Toronto, Can., T. Eaton, Co.
CJCE,	Vancouver, B. C., Can. Vancouver Sun.
CJCF,	Kitchner, Ont., Can. News Record, Limited.
CJGG,	Winnipeg, Can. Manitoba Free Press.
CJCH,	Toronto, Ont., Can. United Farmers of Ontario.
CJCI,	St John, N. B., Can. McLean, Holt & Co., Ltd.
CJCN,	Toronto, Ont., Can. Simmons, Agnew & Co.
CJCS,	Halifax, N. S., Can. Eastern Telephone & Telegraph Co.
CJCY,	Calgary, Alta., Can. Edmund Taylor.
CJGC,	London, Ont., Can. London Free Press.
CJNC,	Winnipeg, Man., Can. Tribune Newspaper Co.
CJSC,	Toronto, Ont., Can. Evening Telegram.
CKAC,	Montreal, Can. La Presse.
CKCB,	Winnipeg, Man. Can. T. Eaton Co., Ltd.
CKCD,	Vancouver, B. C., Can. Vancouver Daily Province.
CKCE,	Toronto, Ont., Can. Can. Ind. Telephone Co.
CKCK,	Regina, Sask., Can. Leader Pub. Co.
CKCR,	St. John, N. B., Can. Jones Elec. Radio Co., Ltd.
CKCS,	Montreal, Que., Can. The Bell Telephone Co.
CKCZ,	Toronto, Ont., Can. Westinghouse Co., Ltd.
CKKC,	Toronto, Ont., Can. Radio Equipment & Supply Co., Ltd.
CKOC,	Hamilton, Ont., Can. Wentworth Radio Supply Co., Ltd.
CKQC,	London, Ont., Can. Radio Supply Co.
CKZC,	Winnipeg, Man., Can. Salton Radio Eng. Co.

Army News by Radio

For several years the ships of the navy and outlying naval stations have been able to get the news daily from what is known as the Navy Press, which goes out by radio from NAA at Arlington each night. A similar scheme is now under consideration by the war department for sending news, especially army news, to its forces stationed at foreign ports and posts out of the regular news channels.

If the present plan goes through, army posts at Hawaii and the Philippines will receive news bulletins at least once a week from a high-powered Pacific Coast station. These radio bulletins would also be sent to army forces stationed at Alaska, Panama, Porto Rico and Cuba, and be picked up by some of the isolated posts in this country, where little if any army news percolates.

Orders affecting all posts might also be announced via radio in the future to save the expense of telegraph and cable tolls.



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RADIO INSTRUMENTS COMPANY

17 North Wabash Avenue **Chicago, Illinois**

Pickups and Hookups

(*Continued from page 34.*)

Chicago Radio Traffic Association, has written the following letter to Frank D. Pearne, technical editor of RADIO AGE, describing how he knocked off thirty-three stations at one sitting. Mr. Marco's letter follows:

RADIO AGE,

Gentlemen:

While essentially a transmitting radio amateur at heart, the writer has followed with a great deal of interest the progress of radio broadcasting, particularly through the columns of your paper, noting therein many of the records set by local receiving stations, especially on silent night. Thinking that possibly some of these records might be broken with the oncoming cold weather, last Monday, October 22, the writer prepared to better the previous record of twenty-six stations on a single silent night by carefully polishing the antenna wire, pepping up the "A" battery, and consulting the weather man, with the results as shown on the appended sheet. The weather man, however, suddenly changed his mind and after starting out nobly during the early part of the evening altered conditions about 8:30, causing it to be a rather poor night.

A careful log was kept of all stations heard, together with times and distances and is herewith presented for the edification of your readers. All work was done on a three-tube set without radio frequency amplification. All stations were audible on loud speaker and in every case except that of KPO, no antenna was used, the pickup device merely being a four-foot loop. The signals from KPO were audible on the loop but hardly strong enough for loud speaker work.

The writer wishes to take this opportunity of expressing the appreciation of himself and the Chicago Radio Traffic Association for the assistance rendered in the recent Second National American Radio Relay League Convention in Chicago, for the cooperation you displayed in bringing our organization before the public eye through the medium of your publication.

Cordially yours,
FRED MARCO.
Secretary Chicago Radio Traffic Association.

Following is the log kept by this sharp-shooting Mr. Marco:

Location and Call	Time	Distance
Philadelphia, WIP	5:28	700
Pittsburgh, KDKA	5:34	625
Pittsburgh, WCAE	5:35-5:46	625
Buffalo, WGR	5:50	500
Detroit, WOX	6:12	250
Kansas City, Mo. WDAF	6:18	425
Philadelphia, WFI	6:28	700
Newark, WOR	6:33	750
Dallas, WFAA	6:56	800
Davenport, WOC	6:59	175
Schenectady, WGY	7:07	750
Washington, D. C. WRC	7:25	650
St. Louis, WCK	7:47	300
Ft. Worth, Texas, WBAP	7:53	800
Cincinnati, WLW	8:06	300
Columbus, O., WBAV	8:10	300
Atlanta, Ga., WSB	8:18	600
Jefferson City, Mo., WOS	8:20	350
St. Louis, KSD	8:45	300
Detroit, WWJ	8:51	250
Memphis, Tennessee, WMC	8:55	500
Troy, N. Y., WHAZ	9:25	750
New York City, WEAF	9:27	750
Omaha, WOAW	9:40	450
Minneapolis, WBAH	9:55	350
Philadelphia, WDAR	10:07	700
Los Angeles, KFI	10:27	1,800
Denver, KFDL	10:41	950
Los Angeles, WHJ	11:00	1,800
Waupaca, Wis., WPAH	11:30	200
Milboard, Kansas, KFKB	11:45	600
Calgary, Alberta, Can. CFCN	11:55	1,400
San Francisco, KPO	12 midnight	1,800
Total miles		22,100

Off 12, midnight; a total of thirty-three stations.

And then, again, here's a New York reader who has a word to say to one of our Kansas City readers:

RADIO AGE,

Gentlemen:

Referring to S. A. Stevenson's letter on Page 17 of your October issue: I picked up practically all his stations and many more, from Luzerne, N. Y. (about 1,400 miles further east). This was accomplished on a modification of the Erla circuit published in a spring number (May) of RADIO AGE. With the exception of WFAA—which was received upon our outdoor aerial—I have heard all of them on an indoor antenna and mostly in August and September.

Very truly yours,
PHILIP G. SCHERMERHORN.
67 West 52nd St., New York.

The editor wishes to thank Mr. Schermerhorn for his letter and for the suggestion accompanying it regarding certain changes in the complete list of broadcasting stations. Letters such as his prove that in trying to help the radio art along (and thereby pay for our own tubes) we haven't been on a dead spot.

If your newsdealer has sold out his supply of RADIO AGE you are likely to miss just the hook-up that you have been looking for. To avoid any such chance fill out the coupon in this issue and send in your subscription. Then you will be safe. And don't forget that with each subscription at the special price of $2.00 a year, or $1.00 for six months, we send you free the popular Reinartz Radio booklet FREE. Address Radio Age, 500 N. Dearborn Street, Chicago, Ill.

A Selective Type of Receiver

(*Continued from page 10.*)

of the rotor windings and connected to the set. These leads must be long enough to allow the rotor to be moved back and forth freely. The ends of the wires on the rotor as well as those on the stator can be anchored by drilling two small holes through the tube, and threading them through. All the turns of wire on both coils should be varnished with shellac, as this will serve to keep them from coming loose.

The method of connecting the taps from the stator A is plainly indicated in Figure 3 and if the coupler is correctly wired in circuit in conjunction with a variable condenser it will provide as good a tuner as can be desired.

A good twenty-three plate variable condenser with a vernier should be purchased and is a necessary unit in future, more pretentions circuits which will naturally follow.

A number of sensitive minerals are used for crystal detectors. Time given to selection of a good detector of this type is well spent, for it is the heart of the circuit. Sometimes high sensitivity discovered in mineral through patient testing permits of a receiving range comparable to that of a tube detector. It must be handled carefully and when a sensitive spot is found care should be taken not to disturb the adjustment. A Galena detector may be mounted in a glass tube. However, it may be desirable to purchase a good fixed crystal detector as there are a number of efficient types on the market.

Making Phone Condenser

A 'phone condenser can be easily constructed. Cut out two strips of tinfoil 3 inches wide and 2 feet long, and three strips of thin paraffined paper, 4 inches wide and 2 feet, 3 inches long. After pasting the tinfoil sheets on each side of one of the paper strips, sandwich the whole between the remaining two paper strips and roll it up, binding the roll with tape or cord. Connections are made to the two tinfoil sheets.

The telephone receivers require no description. However, the ultimate success or failure of reception depends in a large measure upon the quality of the telephone receivers. A discriminating selection of dependable 'phones constitutes a wise investment.

The units which comprise this receiver are mounted upon a bakelite panel, which may then be fastened to a small cabinet. Great care should be exercised in soldering. Use a paste flux, as a soldering liquid is liable to run and cause a short or special program on its own. Instruments should be spaced at about two inches, keeping leads as short as possible.

A Schenectady woman, wife of a schoolteacher, asked WGY to broadcast a request for a flat. She described and specified the number of rooms she desired and the rent it was possible for her to pay and also mentioned the streets she preferred.

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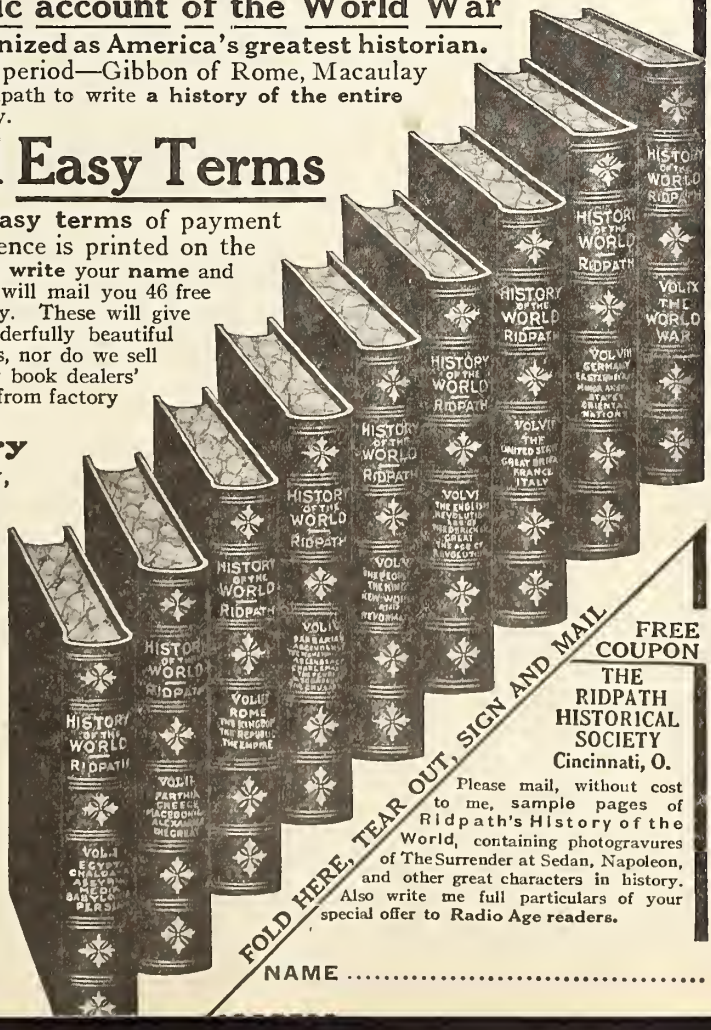
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SERVICE DEPARTMENT FOR READERS

Please remember that Radio Age has one of the best radio instructors in the United States, who is ready to answer any technical question. This costs subscribers nothing.

Building the Haynes DX Receiver

(Continued from page 6)

battery, but it must be remembered that for loud reception, the large tubes must be used.

The plate battery should be of the 22 1-2 volt, adjustable type so that just the proper voltage for the particular tube used may be obtained. Figure 1 shows the general layout for the panel. This shows a fixed grid leak, supported by the wires which connect to it, but as before mentioned, the variable arrangement is better and when used should be mounted on the panel, or in the same way as shown in the drawing. As it is never changed after once being adjusted to the tube used, it will perhaps be just as well to mount it as shown.

Figure 2 is the skeleton circuit showing the conventional idea of wiring. The method of winding the bank-wound coil is shown in Figure 3. Some of our readers will no doubt wish to add two steps of audio frequency amplification to the set, so this has been shown in Figure 4. The rheostat shown in Figure 1 is the carbon type, but this is not necessary, as any standard type will answer just as well, although the resistance of it will depend upon the type of tube used. For the large 200 or 300 tubes, this resistance should be about 6 1-2 ohms, but if the WD-11 tubes are used, a rheostat having 25 ohms resistance will be required.

List of Material

One cabinet to fit 7x10 inch panel.

One bakelite panel, 7x10 inches, 3-16 of an inch thick.

One bank-wound variocoupler.

One switch lever.

Four switch contact points.

Two switch stops.

Eight binding posts.

One variable vernier 11-plate condenser.

Two dials. (Standard bakelite.)

One rheostat.

One socket (To fit the particular tube used.)

One variable grid leak.

One mica grid condenser .00025.

Thirty feet No. 14 tinned copper wire.

In selecting the socket, be sure to obtain one which can be mounted on the panel, as shown in Figure 1.

The above list covers the parts necessary for the construction of the set only. The accessories which will also be required are as follows:

One detector tube.

One set of "B" batteries (22 1-2 volts adjustable).

One pair of good headphones.

One storage battery, or dry cell (depending upon the tube used).

In wiring this set, be very careful to solder all connections and if flux is used, clean off the soldered joints with alcohol after completion.

German Restrictions

Recognizing that radio telephony in Germany has now become an important economic institution, valuable as an agent of communication with foreign countries and within Germany itself, the Federal Ministry of Posts and Telegraphs, which has hitherto exercised a restrictive monopolistic control over all wireless operations, is contemplating an early relaxation of existing restrictions for the benefit of the general public, Consul Richardson reports from Berlin.

Broadcasting has been meagre in Germany. The "Eildienst Gesellschaft" at Berlin has been disseminating financial and commercial news to a clientele of subscribers. The company secured a lease from the government of the wireless station at Koenigswusterhausen in the province of Brandenburg whence it distributes bulletins received periodically from the higher power installation at Nauen. This was a strictly business proposition; the general broadcasting of music, lectures, information and features prominent among radio activities in the United States and elsewhere, has never been done in Germany.

A club, comprising principally amateurs interested in wireless, was formed in Berlin in the early months of this year. One of its declared objects was to induce the government to sanction the free installation of private receiving sets and encourage radio progress. Apparently good results have followed the club's efforts.

It is now understood that a public organization will combine and circulate a program of political, scientific and popular lectures of all sort, as well as music, etc. The federal telegraph administration will probably establish a number of sending stations. Any individual who secures a permit at his postoffice will be authorized to receive this service. The permit, which may be had at a small annual fee, will entitle the holder to use a receiver.

Unauthorized "listening in" will be considered an offense against the Post and Telegraph regulations and will be punishable. Receiving apparatus will be procurable by license holders at specially designated shops. Manufacturers are to be allowed to deliver receiving sets only to such persons as possess the required permits. The sets must correspond with all the technical conditions of the Telegraph administration, and the selling firms must declare their readiness to pay the government a certain proportion of the profits of each sale.

Overcomes Body Capacity

Gives micrometric adjustment outside the field of inductivity.

Tested and approved by amateurs and experts. Enables you to tune distant stations easier and more clearly. Simple as A B C. Installed from outside, no dismantling of your set necessary. Audibility made more natural or less distorted by the final adjustments obtained. One Hunt's Device handles all dials on set or several sets. Costs only one dollar on guarantee of money refunded if not satisfied. Ask your dealer or order direct from

HUNT COMPANY

485 Shrine Bldg., Memphis, Tenn.

PRICES REDUCED

Send card today asking for our complete list of knocked down outfits and radio parts at reduced prices. Our book "Radio Construction for the Amateur" will prove a big help to you. Price only fifty cents. A sample saving follows. You may order any part or parts you desire.

Complete Regenerative Vacuum Tube Receiver.

Approximate range 1,000 miles.

	Our Price	Others
Panel 7"x12" already drilled	$ 1.75	$ 2.50
Cabinet k. d. of 3 ply wood to fit	1.50	2.50
2 three inch dials at 30c each	.60	1.00
16 switch points with nut at .01c	.16	.48
4 switch stops with nut at .01c	.04	.12
8 binding posts, nickel plated at .03c	.24	.48
2 switch levers with 1½" radius at .25c	.50	.80
1 filiment rheostat. Good grade	.50	1.00
1 180° vario-coupler—16 taps	2.75	3.50
1 23 plate variable condenser	1.75	2.80
1 tube socket of high quality	.45	.75
1 phone and 1 grid condenser at .15c	.30	.50
1 set transfers for marking panel	.20	.30
9 feet spaghetti tubing at .04c	.36	.54
1 tube socket support	.20	.30
20 feet soft copper connecting wire	.20	.30
1 1 copy "Radio Construction for the Amateur"	.50	.50
	$11.95	$18.32

Some other articles from our list are:—

Frost head set—2000 ohms	$ 3.45	$ 4.00
Transformer — Audio frequency "Rhamstine"	3.00	4.00
Detector tube—6 volt—"Independent"	2.95	4.00
Two step amplifier parts complete	13.95	21.50

What They Say

A great many unsolicited testimonials with reference to the above k. d. outfit have been received. A couple are:

Roxbury, Connecticut.

Am getting excellent service from one tube single circuit receiver which was bought knocked down from you. Have heard ninety-four stations including PWX at Havana, Cuba and my friends think it is great.

John S. Robinson.

Covington, Tennessee.

The set which we made from your parts is giving good satisfaction. We have heard 1,500 miles or more air line. Have heard KLZ, KWH, KHJ, the last two being in Los Angeles, California. C. H. Owen.

Radio Parts Manufacturing Company

1247 Marlborough Dept. "C" Detroit, Michigan

It Covers The Field!

Over three hundred pages of fully illustrated instructions on how to build and operate sets! Truly a treasure trove for the home radio experimenter!

Written by experts, diagrammed by experts, tested and proved by experts. And all so simple and clear that the beginner can understand.

All kinds of circuits, with instructions on how to make them and amplify them. Readers' circuits on which they have made distance records.

Long Distance crystal sets. How to hook 'em up. How to make the aerials do their darndest.

How to make battery chargers. How to make transformers, coils, condensers, variocouplers, loading coils, dry-cell circuits, audio-frequency amplifiers, one-tube loop aerial sets, two-circuit crystal detectors.

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Send money order or check now.

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500 North Dearborn Street

CHICAGO

Leviathan's Life Boats

Two of the Leviathan's life boats, both ten knot motor boats, have radio transmitting and receiving sets and calls of their own. Life boat No. 67 is WSNA in radio talk, and No. 68 is WSNB. The Leviathan's own call is WSN, her two tenders carrying an additional letter. This is a new departure in American shipping, planned as an additional sea safety precaution. If the Leviathan's radio apparatus should get out of order, or she should be sunk, her two motor boats could communicate with relief ships, within about fifty miles, guiding them to the scene. Each of these radio-equipped craft carries a spark set, and one Kilowatt gas engine generator; they communicate on wave lengths of 300 and 400 meters.

New Army Stations

The army signal corps is busy installing a radio station at Fort Douglas, near Salt Lake City, Utah, which will be the largest radio telegraph station of the army. It will have but one tube, the new ten kilowatt radiotron developed by the General Electric Company, which is building the equipment.

Another similar station is being erected at Leavenworth, Kans., but this station will operate with two tubes and will have a telephone circuit as well as the radio telegraph. The radio circuit between these two stations, the Arlington, Va., station and a land line from Leavenworth to San Francisco, will span the United States. Each of the two interior stations will be equipped with two steel 300 foot towers.

It is the plan of the army radio service not to use coastal stations, that part of the work being handled by the naval communication service, and the army does not desire to interfere with ship to shore communication.

RADIO BARGAINS

REAL VALUES and the best of Merchandise. OUR PRODUCTS ARE GUARANTEED. We enable you to keep the cost of the building and up-keep of your set at the lowest figures and offer you only the most scientific and reliable products.

SAVE ON RADIO

VARIOCOUPLER–180° Bakolite tubing, green silk wire	$ 2.95
MOULDED VARIOMETER, green silk wire, special	3.45
VARIOCOUPLER–180° Jaco special	1.45
VARIOMETER–180° Jaco special	1.45
VERNIER CONDENSER, 23 plate	3.25
TRICOIL REFLEX TRANSFORMER (Specify tube used)	1.85
UNITED-AUDIO FREQUENCY TRANSFORMER, 5 to 1 ratio	3.45
MAGNAVOX Loud Speaker	29.75
HEAD PHONES, Long Distance	4.95
22 1-2 VOLT B BATTERY	1.45
PHONE PLUG, Special	.39
UV 199 SOCKETS	.69
ELECTRIC SOLDERING IRON	2.45
RHEOSTATS, 6, 20 or 40 ohm, special	.48
POTENTIOMETER, 2000 or 4000 ohm	.69

We offer this extraordinary opportunity to buy your radio supplies at unheard of prices. Take immediate advantage by ordering TODAY. Send money order, cash or check.

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Dept. 122, 639 W. North Ave., Chicago, Ill.

For other bargains write for our **Radio Bulletin**

ERLA BLUE PRINTS

Erla Receivers out-distance all other sets with an almost unbelievable volume and a naturalness that cannot be distinguished from the source of reception.

This is the famous Erla Reflex Hook-up. Less than one year old—but has taken the entire nation by storm. Every listener-in raves about it and wants a set of his own immediately.

So easy to construct that anyone who can handle a screw driver can build the set complete in a surprisingly short time—about 1 1-2 hours. Everything is so simple and easy.

NO SOLDERING WHATEVER—ONLY A SCREW DRIVER NEEDED.

One tube hook-up makes set equal to any other two tube set ever invented. Erla two tube set equals four tubes of the best of other hook-ups.

Erla three tube hook-up has no equal up to seven tubes of other sets. This hook-up brings in the most distant stations with a volume equal to powerful local stations. In volume this hook-up equals that of any seven tube set ever devised. And for naturalness of tone has no equal in any other set of any number of tubes. The results from the Erla 3 tube is naturalness itself and cannot be improved upon.

Actual size working diagrams make every thing simple and easy.

Every piece of apparatus and every wire is pictured in its exact place—every article needed is listed on the diagrams.

With such wonderful results to be obtained from an Erla hook-up at a very low cost you cannot afford to waste time and money building other sets that cannot possibly begin to equal Erla hook-up performance.

Diagrams sent same day your order is received. Send P. O. or Express Money Order or Bank draft or Bank Cashier's check. Do not send stamps or personal checks.

Erla Hook-up Diagram Prices

3 sheets for making 1 tube set 25c
3 sheets for making 2 tube set 35c
3 sheets for making 3 tube set 50c

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Sole Distributer of Erla Diagrams for U. S. and Canada

829 Waveland Avenue, Chicago, Ill.

Dealers, Write for Quantity Prices

Amateurs to Compete in Picking Up Calls

HARTFORD, Conn., Nov. 25.—The fourth series of transatlantic tests of the American Radio Relay League between December 22 and January 10 will be a receiving contest as far as American and Canadian amateurs are concerned. They will keep their transmitters silent during the entire period listening for signals from European operators.

Believing that their skill in transmitting has been tried and proved, amateurs on this continent are now going to show the European radio men the courtesy of allowing them to do the sending, while their own sets and ears are sharpened and tuned to catch the incoming signals.

During the first three transatlantic tests North American amateurs were determined to get their signals across the water. Transmission was the big thing and meant everything to them. Even last year when signals from United States transmitters were hurled across the ocean by the hundred, there was only a mild interest in the receiving end. This was a great disappointment to the French and British hams.

With the conditions for the present tests changed and the motives practically reversed everything depends on the receiving and the time previously used by each operator in getting his entire apparatus into trim will now be given almost wholly to the improvement of the receiving circuit. This opens the way for the free-for-all two-way tests which immediately follow the last day of the transatlantics.

The program that has now been arranged by F. H. Schnell, traffic manager of the A. R. R. L., calls for transmission by the British amateur and French operators on alternate nights between 8 p. m. and 1 a. m. eastern standard time, with the latter starting on December 22.

Another feature of the tests is the offer by prominent manufacturers of thousands of dollars worth of radio apparatus for prizes, including a $1,100 transmitter by A. H. Grebe and Company, Inc.

In previous years this season found the American ham going over every detail of his transmitter, devising new ways of crowding stray watts into his set to increase his range. Now the same careful attention is being given to the receiver, while the CW sending set stands idle with the aloof dignity of accomplishment.

It is no novelty for the relaying amateur to rebuild his receiver and it is directly in line with the present movement calling for the installation of the super-heterodyne, or another of the new types of receiving circuits that are fast gaining in popularity. This means as radical a change as it was for the amateur to revert from the old thunder-spark set to the smooth-toned CW in transmission.

The complete failure of the first transatlantic amateur tests in February, 1921, only acted as an incentive for those that followed. Transoceanic amateur radio loomed up as a tremendous achievement. The next year the experiment was considered worthy of sending an American amateur, Paul Godley, to Ardrossan, Scotland, to listen.

There in a fishing village some twenty miles to the west of Glasgow, Godley heard nearly thirty stations and one compete message. The job of getting across was finished to all purposes; it had been proved amateurs could reach over the broad Atlantic on low power.

The business of organizing the third transatlantics was by way of demonstrating that transoceanic amateur radio could become a common thing and was well within the realm of the practical. The signals went over to the tune of more than a score a day, and when the final total was made up, more than 300 stations had landed.

In the "west bound" tests a total of about twenty American amateurs heard European amateur signals primarily from three stations French, 8AB, British, 5WS and British, 2FZ. American hams plan now to surpass all receiving records.

Appeal to Amateurs

THE American Radio Relay League makes an appeal to the American and Canadian transmitting amateur.

The A. R. R. L., in co-operation with the leading radio societies of Europe, is conducting the fourth Trans-Atlantic Tests from December 22, 1923, to January 10, 1923. It appeals to the transmitting amateur asking him to please keep his transmitter silent during the period of the tests. An absolutely quiet air every night during the test is desired.

The American and Canadian amateurs are not scheduled to transmit at any time during the tests as the league desires to lend its best efforts at receiving European amateurs and to try to establish two-way Trans-Atlantic Amateur Communication. First of all, Americans must show that they can copy foreign amateur signals.

Hours of transmission by European amateurs (French and British) will be from 0100 to 0600 Greenwich Mean Time; 8:00 p. m. to 1:00 a. m., Eastern Standard Time; 7:00 p. m. to Midnight, Central Standard Time; 6:00 p. m. to 11:00 p. m. Mountain Standard Time; 5:00 p. m. to 10:00 p. m., Pacific Standard Time. Wave lengths will be from 180 to 220 meters.

The tests are open to the broadcast listener who is able to copy the code. The European transmissions will be at no more than ten words a minute. Over $3,500.00 worth of prizes will be awarded for the best reception reports turned into A. R. R. L. Headquarters, 1045 Main Street, Hartford, Conn.

Seven Standard Stations

Seven radio stations have been named by the Bureau of Standards as maintaining sufficiently constant transmission frequencies to serve as standards for calibrating wave meters and radio-receiving apparatus. Two, KDKA and WGY, are broadcasters.

The stations, located in Massachusetts, New York, New Jersey, Pennsylvania and Maryland, include one naval station, four radio corporations, one general electric and one Westinghouse station. The Tuckerton station of the R. C. A. leads the seven in accuracy, deviating only 0.1 per cent in thirty-six tests of its assigned frequency; all the other stations are, however, not deviating on an average of over 0.3 per cent, and should serve as fairly accurate measures of frequencies.

The seven stations follow with their frequencies and other data:

Station	Owner	Location
WQL	R. C. A.	Coram Hill, L. I., New York.
NSS	U. S. N.	Annapolis, Md.
WQK	R. C. A.	Rocky Point, L. I., New York.
WGG	R. C. A.	Tuckerton, No. 1, N. J.
WSO	R. C. A.	Marion, Mass.
WGY	G. E.	Schenectady, New York.
KDKA	W. E. M.	E. Pittsburgh, Pa.

Commenting on the standard frequency situation, the Bureau of Standards says: "If every radio transmitting station maintained exactly the wave frequency assigned to it, there would be available a standard frequency wave every time any station was in operation. However, at present this is the case only with certain stations, and because it is a matter of difficulty to maintain exactly the assigned frequency, and also because this is of great importance, the bureau has been collecting some interesting data on the subject. As a result of these measurements, it is possible to give out information from time to time on stations which maintain a sufficiency accuracy to be useful as frequency standards. Several stations, which use special means for maintaining constant frequency, have very nearly attained the goal of remaining within two kilocycles of the assigned frequency, as recommended by the Second National Radio Conference.

Transmissions from seven stations may be used in standardizing apparatus, by the methods given in Bureau of Standards Letter Circular 92, "Radio Signals of Standard Frequency and Their Utilization."

Your Radio Problems Solved for 30 Cents in Stamps

IF YOU are constructing a receiving set, a battery charger, a loading coil, a condenser, or a transformer and you need help in the way of clear diagrams and full detailed descriptions of that very thing you may have it by return mail.

We have laid aside a limited number of back numbers of Radio Age for you. Below we are listing the hook-ups and circuit diagrams to be found in these magazines. Select the ones you want, enclose 30 cents in stamps for each one desired.

We advise immediate attention to this as the stock of back numbers is diminishing rapidly.

May, 1922

—How to make a simple Crystal Set for $6.

June, 1922

—How to make a Receiving Transformer.
—Aerials under ground and under water.
—Electric light wires as auxiliary to radio.

September, 1922

—Bank uses radio to serve public.
—How to construct the Reinartz Receiver.
—Federal Act regulating radio.

October, 1922

—How to make a Tube Unit for $23 to $37.
—How to make an Audio Frequency Amplifying Transformer.

November, 1922

—Photo-electric Detector Tubes.
—Design of a portable short-wave radio wavemeter.

December, 1922

—Home-made battery charger for $3.00.
—Principles of radio receiving equipment.

January, 1923

—How to make a sharp-tuning Crystal Detector.
—Fixed condensers in home-made receiving sets.
—Description of loading coil for simple sets.

March, 1923

—Layout and drilling for Reinartz Tuner, with amplification.
—How to make the Crystal Set do long distance work.
—Wired wireless.
—How to make an Audio Frequency amplifier.
—Symbols used in radio diagrams.

April, 1923

—The Kopprasch circuit.
—How to make a one-tube loop aerial set.
—A two-circuit Crystal Set.

May, 1923

—How to make the Erla single-tube reflex receiver.
—How to make a portable Reinartz set for summer use

June, 1923

—How to build the new Kaufman receiver.
—What about your antenna?
—Use of Rubber for radio parts.

July, 1923

—The Grimes inverse duplex system.
—How to read and follow symbols.
—Proper antenna for tuning.

August, 1923

—Construction of the Cockaday four-circuit tuner.
—An efficient two-stage amplifier.
—A simple buzzer transmitting set.

September, 1923

—How to load your set to receive new wave lengths.
—Simple Radio Frequency Receiver.
—Radio with the MacMillan expedition.

October, 1923

—The Four-Tube Neutrodyne.
—Your First Tube Set.

November, 1923

—The Super-Heterodyne.
—A Three-Circuit Tuner.
—How to Learn Code.

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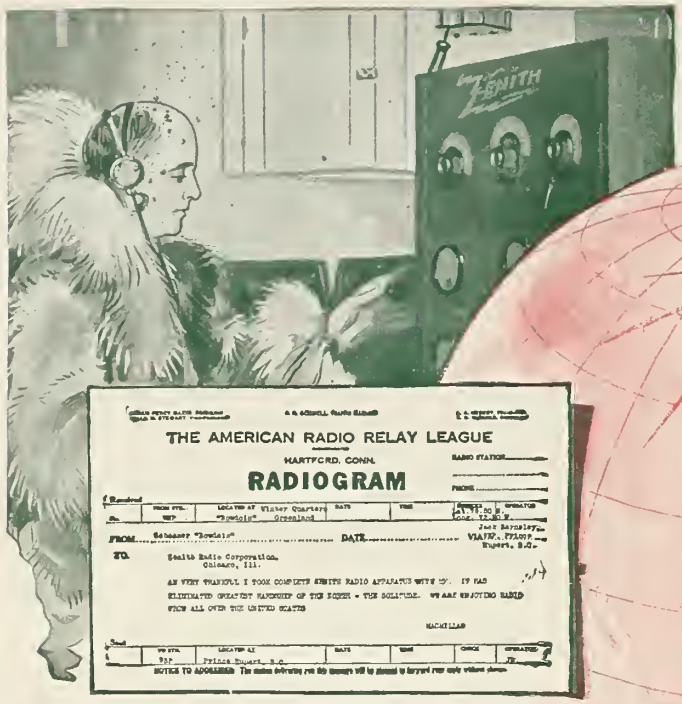
THE AMERICAN RADIO RELAY LEAGUE
HARTFORD, CONN.
RADIOGRAM
FROM... Schooner "Bowdoin" DATE...
TO... Zenith Radio Corporation, Chicago, Ill.
AN VERY USEFUL I TOOK COMPLETE ZENITH RADIO APPARATUS WITH US. IT HAS ELIMINATED GREATEST HANDICAP OF THE ARCTIC - THE SOLITUDE. WE ARE RECEIVING RADIO FROM ALL OVER THE UNITED STATES
MACMILLAN
Prince Rupert, B.C.

ZENITH

Licensed under Armstrong U. S. Patent No. 1,113,149

AT THE NORTH POLE

Inside the Arctic Circle, nine degrees from the North Pole, a little 89-foot schooner is frozen fast in the ice of Smith Sound. Aboard this schooner a group of brave men are enduring, as best they can, the desperate cold of the Arctic—cold that often drops to 60 degrees below zero. Human atoms in a boundless field of ice!

Cold is hard to endure, but far more terrible is the Arctic solitude—unbelievably oppressive. Radio, at length, has broken this spell forever!

Concerts from Honolulu!

Daily, by means of powerful sending and receiving apparatus, the crew of the "Bowdoin" are in communication with relatives and friends in the far-off States. Daily they listen to concerts as far away as Chicago, Dallas, and Honolulu!

When the sanity, the very lives of one's shipmates may depend upon contact with the outside world, none but the ***best*** is good enough.

Dr. MacMillan's Choice—the Zenith

Out of all the radio sets on the market, Dr. MacMillan selected the Zenith exclusively—because of its flawless construction, its unusual selectivity, its dependability and its tremendous ***reach.***

Already his operator, on board the "Bowdoin" ***in Northern Greenland,*** has tuned in several hundred stations. You along the Atlantic who brag a little when you tune in Catalina Island—what would you say if you tuned in Hawaii ***from the Arctic Circle?***

The set that Dr. MacMillan has is a standard Zenith receiving set. And you can do all that MacMillan does, and more, with either of the two new models shown at the right. Their moderate price brings them easily within your reach. Write today for full particulars.

Zenith Radio Corporation
McCormick Building
CHICAGO

Model 4R—The new Zenith 4R "Long-Distance" Receiver-Amplifier comprises a complete three-circuit regenerative receiver of the feed-back type. It employs the Zenith regenerative circuit in combination with an ***audion detector*** and ***three-stage*** audio-frequency amplifier, all in one cabinet.

Because of the unique Zenith "selector," unusual selectivity is accomplished without complication of adjustment.

The Zenith 4R may be connected directly to any loud-speaker ***without*** the use of other amplification for full phonograph volume, and reception may be satisfactorily accomplished over distances of more than 2,000 miles **$85**

Model 3R—The new Zenith 3R "Long-Distance" Receiver-Amplifier combines a specially designed distortionless three-stage amplifier with the super-efficient Zenith three-circuit regenerative tuner.

Fine vernier adjustments—in connection with the unique Zenith aperiodic or non-resonant "selector" primary circuit—make possible extreme selectivity.

2,000 to 3,000 Miles with Any Loud-Speaker

The new Zenith 3R has broken all records, even those set by its famous predecessors of the Zenith line. Satisfactory reception over distances of 2,000 to 3,000 miles, and over, is readily accomplished in full volume, using ***any ordinary loud-speaker.*** No special skill is required.

The Zenith is the only set built which is capable of being used with all present-day tubes as well as with any tubes that may be brought out in the future. The Model 3R is compact, graceful in line, and built in a highly finished mahogany cabinet **$160**

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